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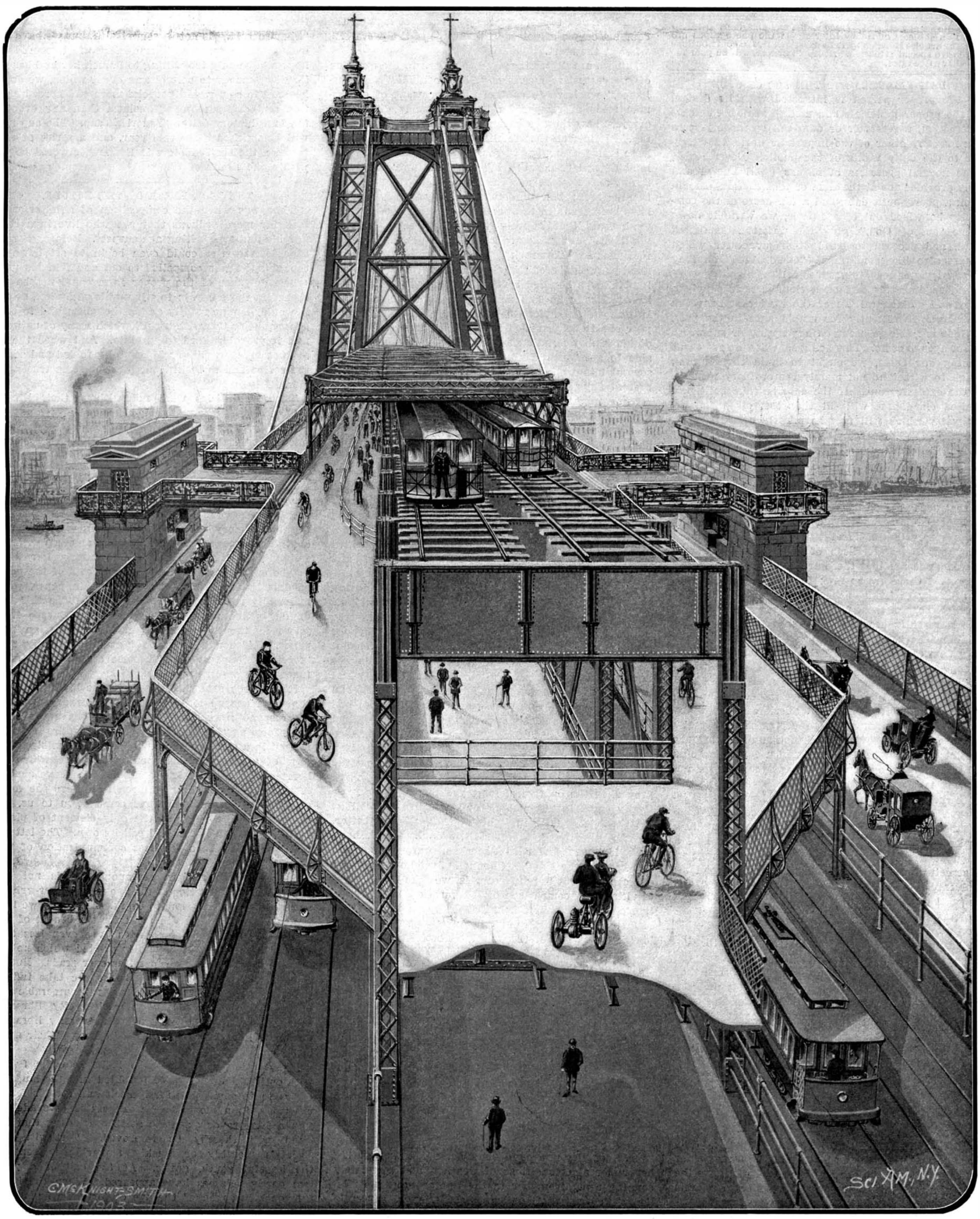

Total width, 118 feet, including four street railway tracks, two elevated railway tracks, two 18-foot roadways, and two foot-passenger and bicycle paths. The view is taken on the approach at the Brooklyn anchorage, looking across the East River.

APPROACH TO THE NEW EAST RIVER BRIDGE.—[See page 46.]

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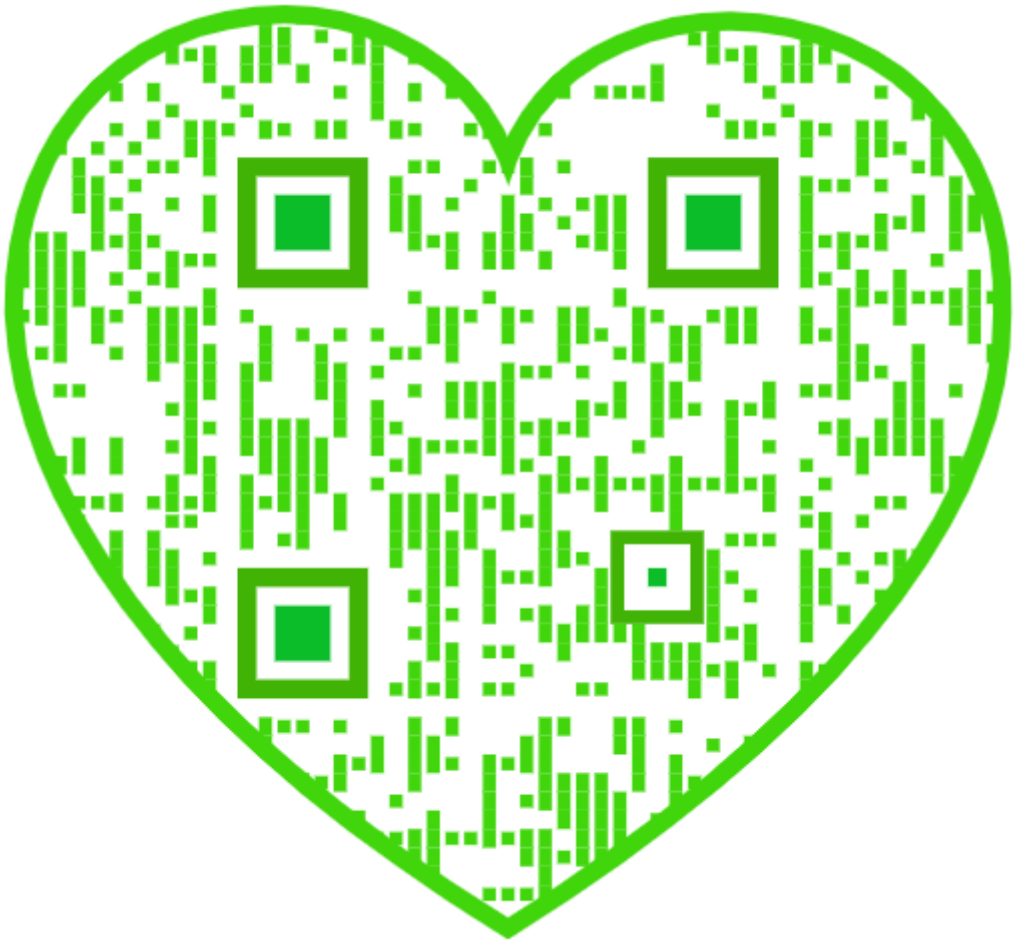

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NEW YORK, SATURDAY, JULY 18, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

DAM FAILURES NOT THE ACT OF GOD.

If the proper person is intrusted with its design, and the proper materials and methods are used in its construction, a reservoir or dam can be made just as secure as any other of the important works that minister to the daily wants of the public. Nevertheless, if the normal processes of nature (well known and easily provided for at the time of construction) should wreck a poorly-built dam, and a few score of the community be wiped out of existence, we write it down as the "act of God," give the unfortunates decent burial, and proceed to build other structures which only require like conditions ("cloudbursts," as they are popularly called) to produce a like calamity.

Now, as a matter of fact, a cloudburst is simply a heavy and sudden rainfall of the kind that has been occurring intermittently for untold ages in the past, and that is liable to occur on any spring or summer's day for ages to come. This being so, when we set about building our dams, we ought to build them strong enough to withstand not merely the ordinary rainfall, but the excessive one. If the dam be thus built, the so-called cloudburst will fill the reservoir with surplus water which will flow harmlessly over its crest, or through the adjacent spillway; and cloudbursts will no longer be commemorated by anywhere from a dozen to one hundred gravestones in the neighboring churchyard.

Considering the awful possibilities of loss of human life that depend upon dam construction, it is astonishing what crude methods are adopted in building many of the reservoirs, big and little, that are scattered throughout the watersheds of the country. Indeed, the wonder is not that there are so many failures, but rather that there are so few; for the question of failure of many of them is merely a question of the occurrence of one of those unusually heavy precipitations, such as recently occurred with shocking loss of life at Oakford Park, Pa. There is no possible excuse for faulty dam construction. Of the more important engineering works it is the one above all others that demands the services of a qualified expert both for drawing up the original design and superintending the construction. It is little short of a crime to allow excessive regard for economy to determine either the form of a dam or the nature of the materials that are built into it, and where a shadow of a doubt exists as to the security of one system of construction over another, it is the bounden duty of the authorities to choose the obviously safer type, even if such choice involves a considerable increase in the cost. A commendable instance of this course of action may now be witnessed at the Croton Dam, where over half a million dollars is being spent in making a change in the structure which will render it secure beyond all peradventure of a doubt. As a rule, the weakest feature in the smaller dams (among which most of the disasters occur) is the spillway, upon which falls the important duty of carrying away the surplus waters of a heavy precipitation—cloudburst, if you will. Although these spillways are able to carry away the flood waters of one hundred ordinary rainstorms, they cannot deal with the one hundred and first; and the surplus waters, seeking an outlet, flow over the crest of the dam itself, washing away the toe of the embankment and bringing about the inevitable collapse. It was in this way that the Johnstown disaster occurred; and an investigation of existing dams throughout the country, particularly of the smaller dams that were not constructed under expert supervision, would probably show that the area of the spillways in numerous cases is insufficient.

"SHAMROCK" AND "RELIANCE."

For the first time in the history of the struggle for the "America" cup the challenging yacht will have the benefit of a series of tuning-up trials against a reliable competitor, carried out in American waters; moreover, the tuning up is taking place over the identical courses off Sandy Hook on which the international contests are sailed. To this extent the challenger is placed to better advantage than any that have preceded her. Moreover, the seven or eight weeks spent by the captain of "Shamrock III." off Sandy Hook, prior to the races, should go far to remove that serious handicap under which previous English skippers have labored of being unfamiliar with the many tricks of the tides and weather during the summer months, such, for instance, as that combination of a southerly wind and a suddenly-falling barometer, which is a sure indication of an early shift of the wind to westward. Those who have followed closely the history of these races in the past will call to mind how frequently the attempted windward and leeward races have developed into close and broad reaches due to this westering of the Sandy Hook breezes. By the way, just here we would suggest, that with a view of making sure of a continuous 15-mile stretch of windward work, the race committee would do well to send off the tugboat that logs off the course a couple of points to westward of the prevailing wind at the start.

But we are digressing; and to return to the question of the respective merits of "Shamrock III." and "Reliance," we have to confess that for want of a common basis of comparison it is extremely difficult to say just how the two yachts stand at the present writing. It is true that "Reliance" and "Shamrock III." have sailed a number of races against two boats, "Columbia" and "Shamrock I.," which themselves fought it out a few years ago in every kind of weather off Sandy Hook; but, unfortunately, since 1899, changes have been made in the handling or the rig of the two trial boats that entirely vitiate any comparison of "Reliance" and "Shamrock III." based upon the performance of "Shamrock I." and "Columbia." First, it must be remembered that whereas in 1899 and 1901 "Columbia" was handled by the best professional skipper in America, who had achieved a high reputation in British waters before he came to this country, this year she is being sailed by an amateur who, in spite of his high reputation as such, is not supposed to be able to get "Columbia" over a 30-mile course within several minutes of the time she would take with the present skipper of "Reliance" at the wheel. The difference might easily amount to from three to five minutes according to the conditions under which the race was sailed. On the other hand, while "Columbia" has deteriorated somewhat, it is confidently believed by the present captain of "Shamrock III." that "Shamrock I." is fully five minutes faster to-day than she was when she met "Columbia" in 1901; and he ought to know, since he was the joint skipper of "Shamrock I." when she raced here. The grounds for thinking that she is faster are, first, that in 1899 her spars were altogether too light for her big sail plan, and buckled so badly that her sails were "all out of shape" and quite unequal to the supreme test of a thrash to windward. Moreover, her designer lay sick in bed during the races; and in his absence, "Shamrock's" weights and the set of her mast were rather clumsily tampered with; indeed, it is pretty generally admitted by our yachtsmen that "Shamrock I." never had a chance to show her best work at that time. When she was used as a trial horse for "Shamrock II.," her rig had been improved, the spars that had shown weakness had been replaced by spars that were stiffer; her trim had been adjusted, and the vessel proved that she had "found herself" by beating "Shamrock II." easily during her trial races. That she was a greatly improved boat received further confirmation in the fact that the yacht she had beaten came over here two years ago and proved, in the opinion of most yachtsmen, to be practically equal to "Columbia," and if sailed as well as that boat, especially in light weather, slightly better. On the other hand, there is little doubt that "Shamrock II." was faster in American waters than she had been in the English Channel. Just how much, no one can tell, but the difference is, we take it, sufficient to vitiate any comparison of "Shamrock III." and "Reliance" on the "Shamrock I."-"Shamrock II."-"Columbia" basis. The writer is inclined to think that "Columbia" is to-day two or three minutes better than her old antagonist of 1899.

Now as to the two new boats themselves, it must be admitted that they represent a remarkable advance in yacht designing; remarkable in the considerable margins by which they have beaten their trial boats, and particularly remarkable in view of the high point of theoretical and constructional development which has been reached in the production of the 90-foot racing yacht. "Reliance" and "Columbia" have met about a dozen times, and in every case "Reliance" has shown an easy superiority to "Columbia," and under certain conditions has proved that the older boat is scarcely in her class. Exactly the same thing may be said of "Shamrock III.," which has shown the same ability to sail completely around her older namesake, beating her under any conditions of weather, and completely running away from her in the lighter breezes. "Reliance" has sailed 34 miles over a triangular 30-mile course in 2 hours, 59 minutes and 20 seconds. "Shamrock III." has sailed over a 30-mile, reaching course in 2 hours, 58 minutes and 37 seconds. The "Reliance" however, made her record time in a 20 to 25-knot breeze, whereas the fast time of "Shamrock" was made in a breeze of between 6 to 12 knots. In the case of "Reliance," 10 miles was to windward and 20 miles of the 30 was reaching; whereas in the case of "Shamrock," owing to a shift of the wind, of the kind to which we have referred earlier in this article, the whole 30 miles consisted of reaching. So with these facts before him, the reader will be able to draw his own conclusions.

The present will be a great year in the history of the "America" cup. America is represented by the three great 90-footers, "Reliance," "Constitution" and "Columbia." Great Britain by "Shamrock I.," II., and III. There is a growing feeling among yachtsmen that after the international cup races are decided, a magnificent marine spectacle and a yachting event of supreme interest could be secured by having a race between these six magnificent boats. It is true, one of them, "Shamrock II.," is not in commission, but we have seen enough of the temper of her owner to feel assured that he would be only too willing to launch her and bend on a suit of canvas to help out an event which, we do not hesitate to say, would provoke more widespread attention and excite more enthusiasm than any event in the long history of the "America" cup. The cup races will be finished early this year, and a series of races between the six 90-footers in September would be well within the limits of the yachting season.

THE BOOK PAPER OF THE FUTURE.

Time was when the composition of a letter was a task far more arduous than we who live in a stenographic and typewriting age suspect. Before your old-time letter-writer could even begin to set down his thoughts, he was compelled to cut and fold his paper (for note-paper of the proper form could not be purchased in those days); to stir up his slimy ink, so that it would flow as readily as his thoughts; and to cut a goose-quill or two with a skill which many of us would find it probably hard to emulate. And when the letter was finally written and carefully folded and sealed, the scribe had to look about him for some trusty carrier.

These difficulties were not without their literary influence. A letter was then a work of art; for it had been long pondered before quill was ever dipped into inkwell. And because the writing of a message, however trivial, was considered no light task, the letter of a century ago has still a certain literary value.

Now in those halcyon days of long, elegant letters, the postal departments of the various governments, which in the course of time sprang up, sought to curb the epistolatory ardor of ladies and gentlemen by charging postage, which varied in amount with the weight of a letter. But the old letter-writer would not be curbed, and frustrated the efforts of the postal officials by inventing a very light, thin paper, which materially reduced the postal revenues. To this very day, this fine paper is still used. In Europe it rejoices in the high-sounding name of "foreign note-paper." Although it is no longer extensively used, "foreign note-paper" may become of far more importance than we may dream.

It has been said that letters in the higher sense of the word are no longer written. Nowadays we only "correspond"; we "beg to state," or "have the honor of informing." The most weighty affairs are dismissed in a short sentence. Thus it is possible to dispose of a mass of correspondence before which the heart of the old-time letter-writer would have quailed. It still remains for our children to discard the forms of polite address which have come down to us, and thus to rob the letter of the only element of picturesqueness which it can still call its own. The letter of the future will be a colorless communication of telegraphic brevity.

Although our modern strenuous life is not conducive to the cultivation of the fine art of letter-writing, some of us still find time to think. And what we have thought finally appears in print for the benefit of posterity—since our contemporaries have even less time to read than to write. Much is printed which no one but the author and the typesetter ever reads. But although we are indifferent to books, we take infinite pains to preserve them. Libraries innumerable are built. There are national libraries, city libraries, county libraries, village libraries, university libraries, memorial libraries, and a host of others. Their name is legion.

Many a hopeful youth who looks into the future with optimistic eyes and who is filled with the laudable desire to do something for himself and for his fellow creatures, in a moment of weakness is persuaded to join a literary or scientific society, trusting that his mind will thereby be improved. Forthwith the society's monthly or weekly magazine is sent to the hopeful youth, gratis. At the end of a year, two portly volumes have appeared. When the hopeful youth has reached the age of forty, he finds himself so far buried in the printed thoughts of his colleagues that he is no longer able to think for himself. And when another decade or two has passed, a material difficulty is encountered in disposing of the

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accumulated matter. Bookcase after bookcase is bought until the walls are no longer visible—all to lodge a treasure for which he longed when it was beyond his reach, and of which he wearies when he can call it his own.

There are times, however, when we appraise this treasure at its full value. And the appraisal usually assumes the form of the depressing discovery that what we have thought has been thought by a hundred men before. There are also times when the spirit moves us to set down our thoughts for the benefit of a presumably grateful posterity; and then we look proudly on the hundred volumes piled up around us. In order to lighten the task of writing what we have to tell, we take down a few of the works that have proven of most value, with the intention of seeking some spot less oppressive than the bookish atmosphere of a library. Good as the intention may be, its carrying out is difficult. Six or eight volumes of generous proportions are not carried without some physical exertion. Twenty or thirty volumes, which may be required during a journey, would not be transported free of charge if the ardent student is otherwise incumbered with luggage. An encyclopedia weighs a hundred pounds or so; and its imposing length covers a majestic yard or two of a bookshelf. In a word, the size and weight of our volumes hamper us everywhere. The greater the value placed by the publisher on a work, the statelier is its appearance. Paper almost as thick as cardboard in *éditions de luxe;* broad margins; large type; ample spacing—everything contributes to render the book more unwieldy.

Naturally the question arises: Shall we always be able to manufacture enough paper to meet the ever-growing demands of the insatiable author and publisher? Our forests are not inexhaustible; and wood pulp is the material from which most paper is made. Even now the primeval forests of sparsely populated regions are swept away to satisfy the intellectual needs of more thickly populated lands. But what will happen when all countries are civilized, when all nations alike will need trees?

Clearly we must soon adopt the expedient of our letter-writing forefathers. We must stint ourselves in some way—not perhaps by curtailing the number of books which we write, but by reducing their weight and size. By microscopic print the end is not to be reached. Some improved form of "foreign note paper" must be invented to meet the requirements of the printer—a paper thin but not transparent, and capable of receiving an impression on both sides. Such a paper has not yet been generally introduced; but it must come sooner or later.

That the making of a paper having the requisite properties is not a technical impossibility was proven by an interesting exhibit which probably escaped the notice of many who visited the Paris Exposition. The exhibit in question was made by the Oxford University Press and consisted in part of works printed on "Oxford India paper," remarkable for its extraordinary thinness, toughness, and opacity. Specimen pages of the Bible, Shakspere, and the Encyclopædia Britannica printed on the new and on the ordinary paper and bound in volumes of the same form, proved that the size of a book could easily be reduced by one-half without impairing the legibility of the text. How this new paper is made cannot be learned. But whatever secret process may be employed, it is certain that the exhibit was made in a spirit that should commend itself to paper-makers and to book-makers.

PRESENT CONDITIONS IN ALASKA.

BY J. H. THOMPSON.

The month of June is the date of the opening of the summer season in Alaska, and the amount of work planned for this season devoted to developing and exploiting the resources of that vast territory far exceeds that contemplated or accomplished at any prior time. In the interior every tributary of the Yukon River has been more or less prospected and many of these stream beds and the adjacent country are being worked to a profit. The Klondike district of the Northwest Territory of Canada, just one hundred miles up the Yukon from the imaginary line which intersects the two countries, does not give promise of increasing its output of gold over that of last year, which amounted to $12,000,000. Lack of new strikes or discoveries since the memorable find in 1896 has set a limit on the output of this famous mining camp. It was reached two years ago and is now on the decline, having at this date produced over $80,000,000 in gold. But while the richest spots are a thing of history, the importation of modern machinery has made it possible to work to a profit low-grade propositions. Large pumping plants and heavy dredging machinery have ameliorated the condition of the mining operator and reduced expenses to a reasonable basis. One company has taken to Dawson this year 450 tons of machinery, the cost of transportation of which exceeded the original cost of the plant. Freight rates and high wages for day labor have deterred the rapid development of the Klondike district. Now it can be safely stated that the wages for day labor will average $4.50 and board per day. The Canadian government pays $5 and board to all of its employes on government work.

The Nome mining district is daily increasing as a producer and is being extended over a vast expanse of territory, projecting from Golovia Bay to the Arctic Ocean and east inland from the Behring Sea as far as the difficulties of transportation will permit. As yet it has not settled to a defined limit, for prospectors are daily finding prospects in isolated districts which give evidence of substantial discoveries. The future of the northern mining camp, with its rigorous climate during all seasons of the year, is very promising. The known wealth in placer gold and the prospects of the development of the mineral veins and coal beds, of which there are ample indications, give evidence that for many years to come this section will be a great producer of valued minerals and a large consumer of produce and mercantile products.

The year just passed proved very profitable to this mining section, and as a consequence many necessary and costly works were begun. The need of water had curtailed development work heretofore, and to supply this need large ditches, tapping streams at a distance of twenty-five miles from the center of the mining section, were begun and the work vigorously pursued until cold weather made it impracticable for further work.

One of the heavily interested corporations has now under its management one narrow-gage railroad running out of Nome to its properties, a distance of five miles, and now has under construction a similar railroad from a point south of Nome (Golovia Bay) to Council City, the center of a mining district. This company has in operation on the bank of the Snake River, near Nome, a pumping plant costing $75,000 at the builders' in Chicago, which delivers through a pipe line to an elevation of 800 feet, 3,000 gallons of water per minute. Another company sent 900 tons of machinery to Nome in one shipment last season and will construct a large pumping plant this year.

Day labor, as well as those employed in the trades, had a most prosperous season in the past year. The average wages paid for labor was $5 per day and board. Some mining operators were compelled on account of lack of labor to pay as high as $6 per day and board. It may seem strange that more laboring men do not flock to such a place; but every man who has served in this capacity will concur in the statement that every man is expected to earn the wages he is paid—that the laborer is well worth his wages.

Two new districts have recently attracted attention. They are known as the Tannan and the Copper River districts. They are deep in the very heart of the territory. Discoveries made last summer have developed so satisfactorily that this new find bids fair to gather round it a very substantial mining community. Valdez, a town on Cook's Inlet, the point from which all the miners start for this new discovery, is the gateway of a tremendous expanse of practically unexplored or unprospected country.

The need of some practical method of transportation is keenly felt. Last season the price of freighting to these new camps was $1 per pound. This problem can be solved by the building of a railroad. A survey has been made from Valdez to Eagle City, on the Yukon, traversing the heart of this district; but as yet no steps have been taken for building the railroad. The prospects indicate that there is a vast amount of wealth in minerals and unnumbered acres of agricultural and grazing land in this district awaiting development. This season one thousand head of cattle will be driven to these grassy plateaus and slaughtered in the fall of the year. Another party contemplates bringing a similar number of sheep for the same purpose.

Along the coast of Alaska, especially in Cook's Inlet, men have prospected for oil for the past three years. During October last a gusher was struck seventy miles south of Valdez. All the adjacent land was taken up and recorded and companies formed for the further exploiting of the field. Since then large quantities of supplies and machinery have been forwarded to this point, and it is expected that further developments will reveal the existence of a considerable oil field. The surface prospects are decidedly encouraging. The gusher referred to, which is the pioneer in Alaska, was struck at a depth of three hundred feet, and the oil proved of an exceptional quality.

The annual spring stampede from the Pacific coast cities to Alaska is in progress. It is expected that at least 10,000 men will go into the new mining camps, 200 miles inland, while many others will be attracted to the new oil fields.

Since the development of the resources of the Pacific coast the value of its fish has proven to be one of its richest heritages, and to-day Alaska can claim a paramount position in that respect. Last year over $8,000,000 worth of salmon was shipped from its ports. It might be well to state that Mr. Seward paid $7,200,000 for these Russian possessions. Salmon canneries are now located on almost every stream of any importance from Mary's Island, the most southern point of the territory, to the Arctic Ocean, and this year's output will far exceed that of the past year.

These canneries encroach upon the inalienable rights of the natives, sometimes depriving them of their livelihood. This is a serious matter and will soon resolve itself into a difficult problem.

SCIENCE NOTES.

In a note entitled "The Ear a Manometer," M. Pierre Bounier sets forth a new theory of hearing, to wit, that the liquid of the interior ear moves as a whole, so that audition is a hydrodynamic, not an acoustic, phenomenon. The ear is not a resonator, but a registering manometer, in which variations of pressure are alone recorded. He points out that the nerve of the labyrinth is thus brought under the common law of the apparatus of sensation.

Mdme. Curie, having obtained about a decigramme of pure radium chloride by fractional crystallization of radiferous barium chloride, has endeavored to determine the atomic weight of radium. The results of her experiments show that the atomic weight is 225 (taking Cl = 35.4 and Ag = 107.8), with a probable uncertainty of not more than one unit, radium being considered a bivalent element. The chemical properties of the element include it in the alkaline-earthy series, in which it constitutes the higher homologue of barium. In accordance with its atomic weight it should be placed below barium in Mendeleeff's table, and on the same line as thorium and uranium. Pure anhydrous radium chloride is stated to be spontaneously luminous.

The largest factory of chemicals in the world is said to be the aniline and soda establishment of Baden, in Ludwigshafen-on-the-Rhine. The works employ 148 scientific chemists, 75 technical engineers, 305 clerks, and more than 6,000 workingmen. There are 421 buildings for factory purposes and 548 dwellings for laborers and 91 for officials. One hundred and two boilers furnish steam for 253 engines with 12,160 horse power. Gas is extensively used as fuel. Five large steam hoists on the banks of the river are used for loading and unloading. The works own a vessel, with a capacity of 600 metric tons, for the transportation of sulphuric acid. A network of railways, having a total length of 27 miles, connects with the state railroad system. Three hundred and eighty-seven cars are owned by the factory.

As a result of the numerous micro-chemical experiments with calcium metaphosphate, A. L. Herrera in Memorias de la Sociedad Cientifica "Antonio Alzate," Mexico, propounds the theory that natural protoplasm is composed of this salt, impregnated with various substances absorbed or secreted under special osmotic and electrolytic conditions. Transparent vacuolated bodies of homogeneous structure, and of the consistency of natural protoplasm, have been observed, which have very striking analogies with protozoa in general, changing shape, swelling, dividing, and, on treatment with salt-solution, forming a plasmodium. Prof. Herrera shows several micro-photographs of the artificial protoplasm which he has prepared, and which consists solely of calcium metaphosphate, in actual movement in salt solution.

We have heard so much of what is poetically termed the "teeming millions" of China, that the official census recently published by the Imperial Treasury Department of China is of no little interest, since it furnishes a method of determining just how many "teeming millions" there are. It appears that the Celestial Empire contains 426,000,000 inhabitants, and that China proper—the eighteen provinces—contains 407,000,000. The table is given in the Mouvement Géographique of Brussels, to which readers are referred for details. The number of inhabitants per square kilometer varies from 201, in Ho-Nan, to 32, in Kan-Sou, and is, on the average, 103 in the eighteen provinces. In Mongolia, the number is 0.7; in Manchuria, 9; in Yibet, 5, and in Turkestan, 0.8. For comparison we may recall that Germany has 105 inhabitants per square kilometer; Belgium, 220; and the United Kingdom, 130.

The agricultural authorities at Barbadoes have been carrying out investigations to ascertain the effect produced by falls of volcanic dust on insect pests and other parasites of the field. The first examination was made after the fall on October 16 last to study the results. Taken on the whole, the dust appeared to have exercised but little effect, most of the insects having hidden themselves during the actual fall. Observations on the following day showed that the greater number of insects had escaped unharmed. Two-winged flies suffered severely, there being a notable absence of them after the dust. "Cow bees," "wild bees," and other hymenoptera suffered in the same way. Other groups practically escaped, so that the dust had little, if any, effect on the pests. The destruction of two-winged flies, "cow bees," etc., is not regarded as beneficial, as many of these serve to keep caterpillars and other pests in check.

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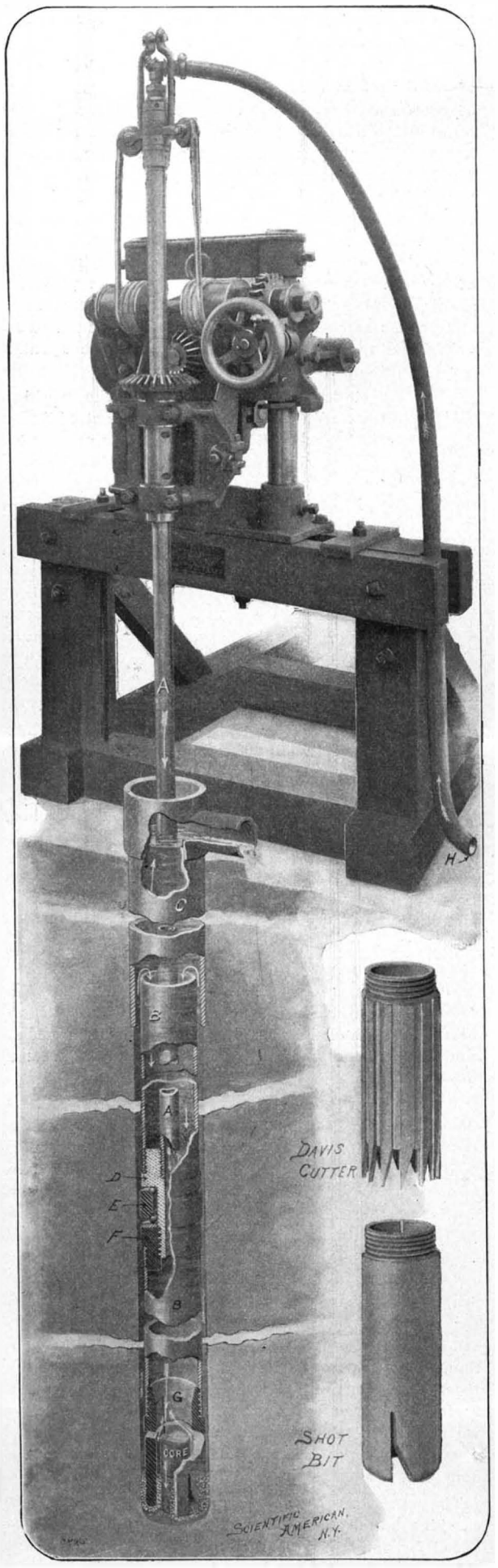
CORE DRILLING WITHOUT DIAMONDS.

Forty years ago, when Leschot invented the diamond core drill, black diamonds were valued at $3 a karat; now they are rated at $50. This advance is attributable, not to a diminution in the supply of the diamonds, but rather to the ever-increasing demand for them. Core drilling is indispensable in a great variety of engineering and mining enterprises, affording, as it does, a means for drilling out a sample core or column of rock, which enables one to tell at a glance the exact nature of the substrata. Heretofore core drilling could be done only with diamond bits. Now, thanks to the efforts of an Australian inventor, we are provided with two very efficient yet inexpensive substitutes for this



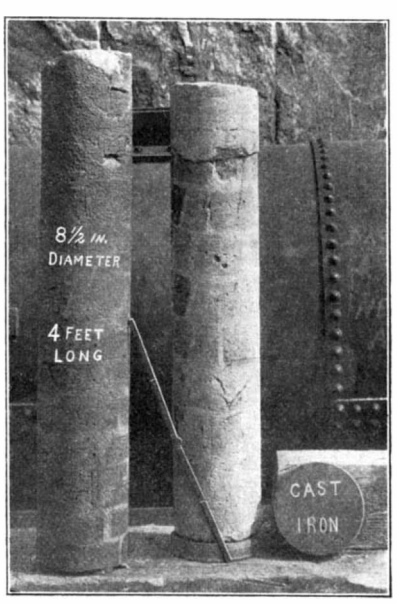
CORE DRILLING WITH STEEL SHOT INSTEAD OF DIAMONDS.

high-priced tool. Mr. Davis' first attempts were directed to the construction of a toothed bit or cutter made of hardened steel. With this he was very successful in soft and moderately hard rock, but for the hardest formations he still had to use a diamond drill. It was not until Mr. Davis had invented the "shot bit" that the diamond drill could be entirely dispensed with. This bit is a soft steel cylinder in connection with which small chilled steel shot are used. The bit grinds the shot into the rock, thus gradually wearing it away, or to be more correct the action of the shot on the rock is one of crushing rather than grinding, and for this reason the smooth bearing surface of the shot bit shows but little wear.

The arrangement of the drill and its accessories is shown in the accompanying engraving. The hollow drill rods *A* are rotated by any available driving means through the medium of the gearing illustrated. The lower drill rod is surrounded by a "calyx" or tube *B*, and the two are joined at their lower ends by a plug *D*. The center portion of the plug serves as a bearing for a protecting ring *E*, and on its lower end a ring *F* is threaded, while to this the core barrel is attached. Either the shot bit or the cutter can be threaded into the lower end of the core barrel. The shot bit, which is shown attached to the core barrel, is provided with a triangular notch in its lower end, one of the walls of the notch being vertical and the other forming an angle of 30 degrees therewith. The steel shot, which are fed through the hollow rods from the top, are carried by a current of water under this notch, and the inclined wall drags them under the edge of the shot bit. The sizes of shot used vary with the nature of the rock to be drilled, some being as large as duck shot and the smallest being very much finer. The working edge of the shot bit is rounded, so that the shot grinds not only directly beneath the drill, but also to a certain extent at the inner and outer sides, thus cutting out proper clearance for the operation of the drill. Water which is pumped into the hollow drill-rods through the pipe *H* passes out under the bit and up the annular space outside the core barrel, carrying with it the sludge or fine particles ground up by the shot. The current of water flows with great strength up as far as the top of the calyx, but here it will be observed that the annular space widens considerably, so that the current is reduced and the sludge it carries drops by gravity into the calyx. The calyx, therefore, provides an additional record of formations penetrated. It is particularly useful when drilling with the cutter bit through matter which is too soft to form a good core.

The cutter bit is clearly illustrated in one of our detail views. It is made of steel, hardened by a special method to give it just the proper temper for the work to be performed. The teeth are very long and sharp and have an alternate inward and outward set, similar to that of saw teeth, so as to cut out the necessary clearance. The cutter does not cut through the rock with a constant feed, but rather with an intermittent motion which is due to the torsional elasticity of the rods; that is, the teeth at the first "bite" on the rock will be checked for an instant until, with the assistance of the energy accumulating in the rods, they break their way through the obstruction and take a fresh bite. The action is, evidently, similar to that of chipping away stone with a mason's chisel.

In order to prevent too great a leakage of water through the loose soil or gravel which usually covers the bedrock, the casing *C* is provided. The weight of the drill rods is ordinarily sufficient to properly feed either the shot bit or the cutter. When additional pressure is necessary, this may be exerted by turning the handwheel shown in our illustration. The handwheel is geared to a pair of winding drums, on which are coiled the ends of a strap passing over pulleys at the top of the drill. When it is desired to remove the core, coarse gravel is poured down the hollow tubes, which wedges in between the core and core barrel so tightly that on lifting out the core barrel the core breaks away and comes up with it. The efficiency of the "shot bit" is indicated by the two cores illustrated herewith. They were drilled out of an old structure at the New York Aqueduct. The shot bit made its way easily through the brick and cement, and was not stopped even by the plates of cast iron which formed part of the structure.



CORES DRILLED THROUGH BRICK AND CAST IRON BY THE STEEL SHOT PROCESS.

AN ELECTRIC HAMMER.

A form of electric hammer is now widely used, a description of which may be of interest to some of our readers. It will be seen from our illustration (Fig. 1) that the hammer is driven by a flexible shaft

Fig. 1.—THE HAMMER IN USE.

which transmits the requisite power from a small portable electric motor placed in any convenient position. The wires which are shown running from the motor to the handle of the instrument are connected to a push button in the handle, by means of which the motor can be switched in and out of the circuit at will. This arrangement and the whole mechanism of the hammer are shown in detail in our second figure. In the handle, *d'*, is placed a push button, *E*, which carries at its lower extremity a cut-out, *e'*, and just above it a contact piece, this latter forming a shoulder which rests against a flange in the tube inclosing the push button. Pressing against this flange from above is a spring, by which the push button is normally projected out of the casing. Two springs form the terminals of the wires, *s*, and are in contact with the cut-out, *e'*, so that the motor circuit is open, and no power flows to the hammer. On pressing down the button, *E*, the contact piece above *e'* touches each of the terminals of *s*, and the hammer is set in motion. For convenience the wires *s* are best taken through the lug, *s*, where they pass close by the flexible shaft to the motor. The working parts of the hammer itself are disposed as follows: The flexible shaft is continuous with the shaft, *B*, the crank of which works within the expanded portion of the casing and bears the connecting rod, *I*. This connecting rod is coupled to the crank in such way as to be readily removable,

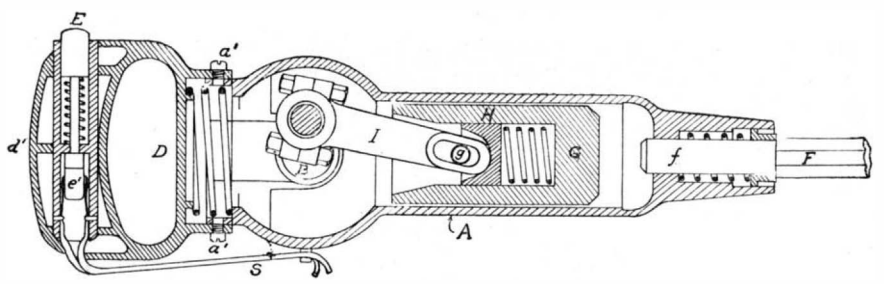


Fig. 2.—LONGITUDINAL SECTION THROUGH HAMMER.

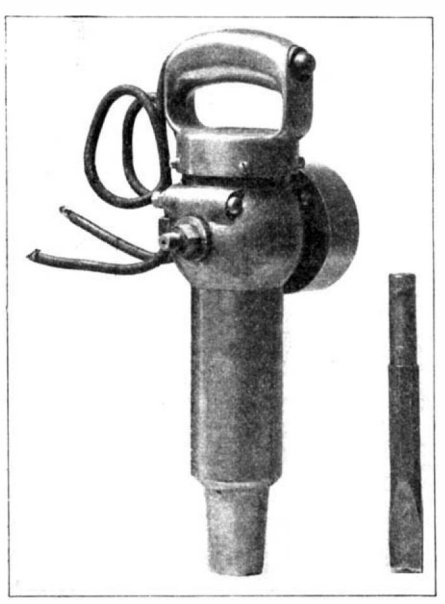


Fig. 3.—THE HAMMER AND ITS TOOL.

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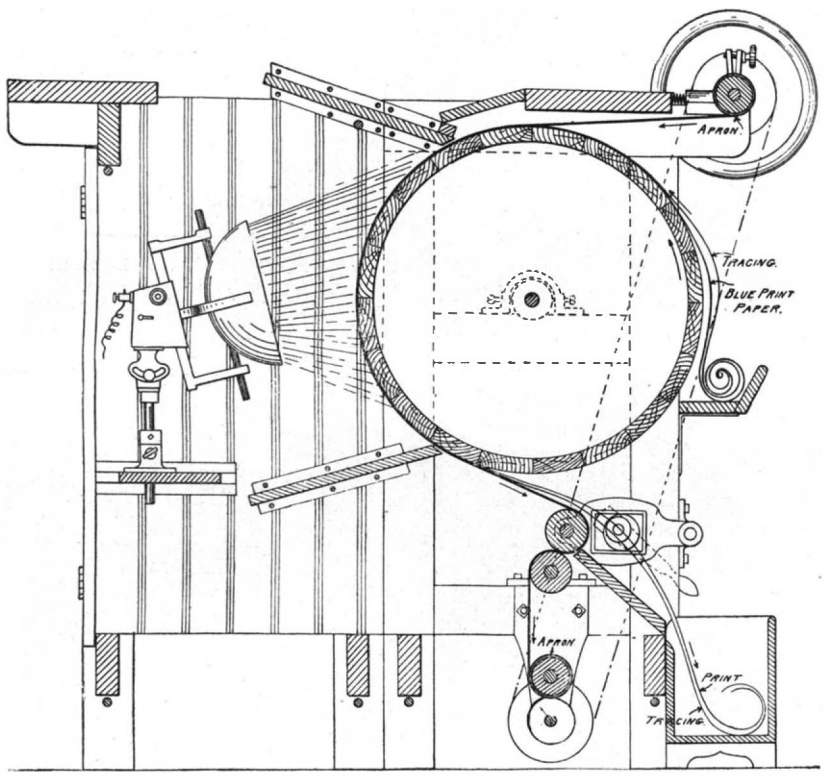
the casing consisting of two parts joined together and fastened by the set-screws, a' a'. These set-screws fit into slots in the outer flange of the casing, and a spring, while keeping the two portions of the casing



CROSS-SECTION OF BLUE-PRINTING MACHINE.

in position, takes up much of the vibration of the tool when working, thus protecting the hand from jolts.

At its farther end the connecting rod *I* has a longitudinal slot through which passes the pin, *g*, attached to the plunger, *H*. This latter works in a cavity of the hammer, *G*. The plunger is shaped to fit the end of the rod, as shown, so that at each revolution of the crank, a blow is transmitted from the rod *I* to the hammer *G* through the plunger *H* and the spring in the cavity of the hammer. This latter is therefore a floating hammer, not being rigidly connected to the power shaft and its blow depending entirely upon its momentum.

By this construction the shaft is relieved of all jar due to the hammer striking the end of the tool, and thus the even running of the shaft without undue racking is insured.

It is evident that the instrument can be worked from any other power source instead of an electric motor. But the latter is found by far the most convenient. The hammer can be used in places which would be inaccessible to instruments of the pneumatic kind.

The shaft is driven at high speed, and the motion is kept uniform by means of a flywheel situated within the flat cylindrical portion of the casing shown at the rear of the instrument in Fig. 3, which also shows the tool. This latter, *f*, *F* in the diagram, has a cylindrical portion, *f*, fitting into the anterior end of the instrument, and a thicker portion, *F*, of polygonal cross-section, preventing the tool from entering beyond the shoulder formed by this polygonal portion, except in so far as the collar against which that shoulder presses is forced inward against the spring behind it by the hand holding the instrument. By this arrangement the workman is enabled to regulate the blows of his instrument.

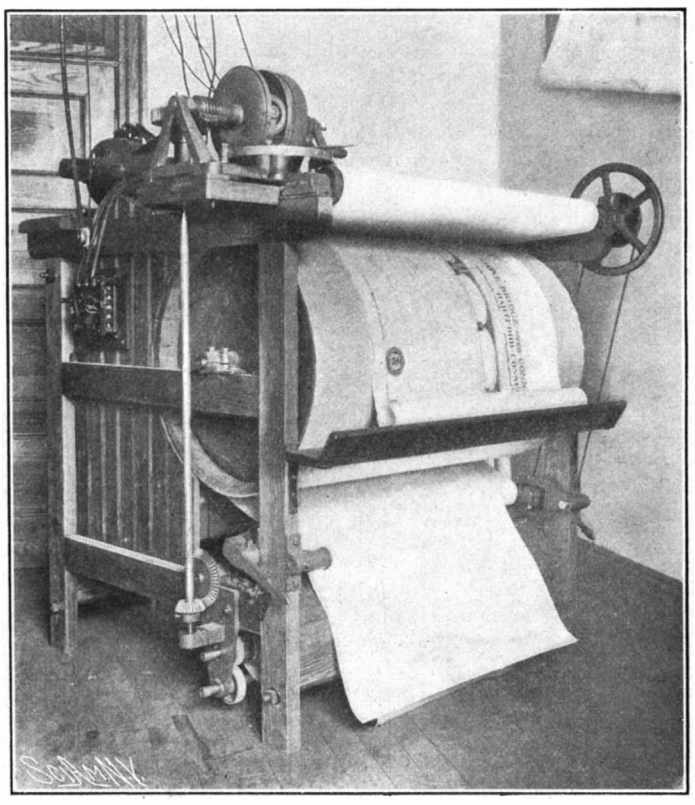
ELECTRIC BLUE-PRINT MAKING.

BY GEORGE J. JONES.

The marvelous development of the blue-print has been responsible in no small measure for the rapid manner in which great engineering and mechanical tasks are now performed in the workshops of this country. Our facility to successfully carry out stupendous engineering undertakings has within a few years carried our industrial fame to the four corners; and that the tremendous feats which have been done with such marvelous rapidity by our engineers and our industrial establishments have been made possible by the humble blue-print, is conceded by those who know.

It has been only a few years since the virtues of the blue-printing process were first recognized, and since that time there has been an almost complete revolution in workshop and building methods, and the manufacture of these blue-prints has developed into a vast industry. So formidable has the business grown, that it has been found necessary to find a substitute for the sun for the purposes of printing, not only for the reason that the sun is more or less an uncertain commodity, but because he can not be induced to work overtime, no matter how serious the emergency.

Naturally the electric light has been resorted to, and while it is somewhat slower than the sun, prints can be turned out night and day. These machines are of recent invention, and it is by their use that certain large photographic plants are enabled to hang up signs reading something like this: "Blue-prints made on short notice. Night or day. Rain or shine."

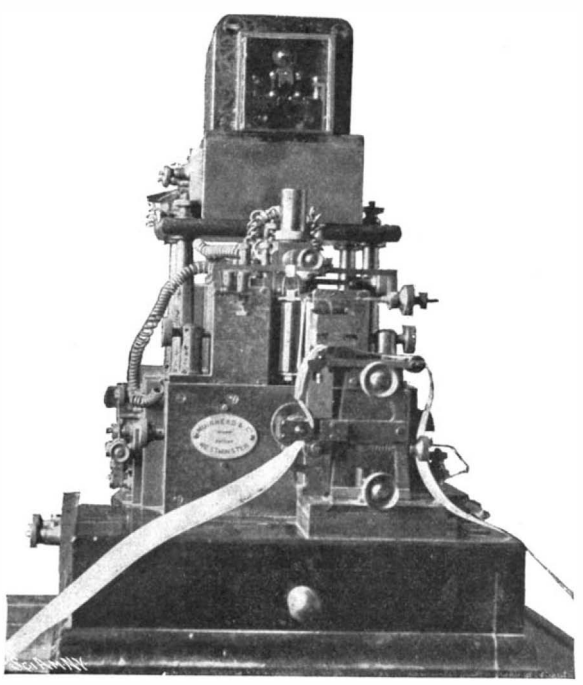


A BLUE-PRINT-MAKING MACHINE.

Probably the most complete of these machines is one which is continuous in its operation, and which is fed by the operator with great lengths of tracings and blue paper in much the same manner as the washerwoman feeds the wet clothes into the wringing machine. This is known as the Federal, and is shown in the accompanying cuts in perspective as well as section, clearly revealing its operation as well as its general appearance. The large wooded drum, around which the tracings and printing paper pass, is moved either by a connection with the shafting or by an electric motor mounted on the apparatus, the speed of the drum being regulated by a device shown on the top of the machine. A traveling apron of transparent material takes the place of the glass in the printing frame of the ordinary type, and as it is under tension at all times, it insures an even and close contact at all points. This apron is wound on a small drum at the top, and after passing along the large drum where the contact and exposure take place, it is wound up on the drum below; after the printing operation has been completed it is rewound by hand back on the upper drum. In the rear of the machine are three arc lamps with reflectors, which concentrate the light on the tracings which, with the exposed prints, drop out into the box in front. The blue paper may be kept in a roll ready for use on the upper front part of the machine, or may be fed in small sheets with the tracings where the work being done is of ordinary size.

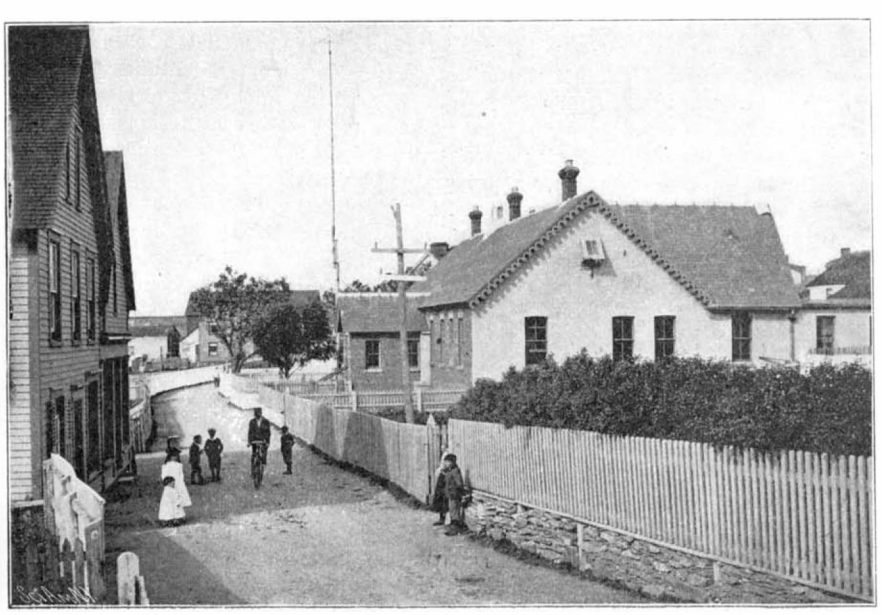
These machines are made in two widths, thirty and forty-two inches, and the apron supplied with them is seventy feet long, and prints of this size can be made as readily as smaller ones where it is desired. The ability to make prints of this size greatly enlarges the sphere of usefulness of the blue-print.

A feature of this machine quite as valuable as its capacity for making large prints is the fact that it can

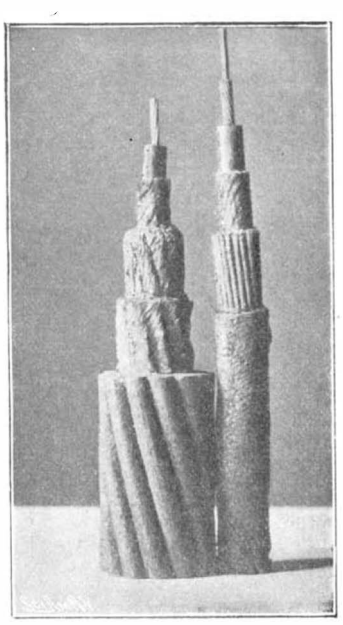


The Siphon Recorder.

A Corner of the Battery-Room at Heart's Content.



The Station at Heart's Content.



Sections of the Cable at the Shore End and Deep-Sea Portions.

THE FIRST ATLANTIC CABLE STATION IN AMERICA.—[See next page.]

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be readily turned into a sun-printing machine. At such times as the sun is available this represents an economy of some considerable moment, for it not only saves the cost of the current, but also makes the prints somewhat quicker, thereby increasing the capacity of the apparatus.

So general has the use of blue-prints become, that it is now one of the features of the business of the cabinet maker and office furniture manufacturer to build cabinets designed especially as a receptacle for these sheets. For large offices they are generally designed to meet the particular requirements of the establishment, and are necessarily quite extensive. Smaller sizes are, however, carried in stock by the larger dealers in this sort of material. The cabinets consist of a series of receptacles of varying sizes, with the openings protected by means of hinged and falling doors. In the center and toward the top is a small drawer, with an index system in which a record of each print in the cabinet is kept. The top of the cabinet offers a smooth flat surface for the examination of the prints.

THE FIRST ATLANTIC CABLE STATION IN AMERICA.

It is a curious coincidence that the first signal sent from the Old World to the New by means of wireless telegraphy should have been received not far from where the first Atlantic cable message was also received. Signal Hill, which marks the entrance to the harbor of St. Johns, Newfoundland, was the site of the first Marconi station in this country. On the shore of Trinity Bay on the northeastern coast of the same island is located a little village bearing the attractive name of Heart's Content. In it reside less than a thousand souls, and it differs little in appearance from other Newfoundland settlements, with the exception that the houses are somewhat more pretentious and it does not contain as many flakes for drying codfish. This is because the town owes its existence to the fact that it is one of the terminal points for the cables which extend between the eastern and western hemispheres. Heart's Content might be called the birthplace of submarine communication, for in one of its buildings was received the first message sent under the seas—in which Queen Victoria congratulated the President of the United States upon this connection between the nations. The cablegram consisted of ninety words and required sixty-seven minutes to transmit, owing to the crudity and the imperfections of the apparatus. Shortly after being placed in operation the cable failed entirely as a means of communication. Seven years later the "Great Eastern" entered the harbor of Heart's Content, and another cable was completed, to be severed within a year. Again this famous steamship crossed the Atlantic with a third cable, and her crew finally spliced the one laid in 1865, so that the Newfoundland operators could receive messages over two separate systems, the newer one containing no less than 4,000 tons of wire and covering.

In the early days of the cable service the receipt of messages depended largely upon the operator's eyesight, as the words were indicated by electric flashes of different lengths, which appeared on the surface of a small mirror. Then came the invention of Lord Kelvin—the siphon recorder—which has been in service nearly thirty years, translating the breaks in the electric current sent under the sea into legible characters upon a roll of paper with which it is connected. So many communications are going to and fro between the two worlds that although other cables have been laid, a force of nearly thirty operators is required in this little town in the far North. They are divided into a night and day staff, and are in charge of a general superintendent—Mr. William Bellamy.

The cable office is the principal building in Heart's Content—a plain two-story structure built of brick and stone. The principal apartment is the operating room, where are placed the siphon recorders and other instruments. Considerable space, however, is required for the battery, as a large quantity of chemicals are required to fill the several hundred cells used. These are placed in racks in the battery room, and the services of one man are continually required to clean and replenish the jars. The cables are laid to the operating room through an underground conduit which is walled with masonry. The shore section and that which extends into shallow water is considerably smaller than the deep-sea cable, as it requires less protection. The one which was last laid consists of eighteen strands, each strand composed of seven iron wires forming a metallic sheath for the copper wires which convey the electric current. The copper is embedded in gutta percha incased in hemp which is saturated with a combination consisting principally of beeswax, paraffine, and oil; this casing is surrounded by the iron wire, which is also covered with a waterproof compound. Several coatings of the hemp covering are wound about the gutta percha, so that the copper wires of the deep-sea cable are really protected by five wrappings. The shore section differs from the deep-sea principally in the absence of the wiring on the outside.

The services of a repair ship are frequently needed, as the terminals of the cables are liable to be injured by the masses of ice drifting down from the Arctic regions throughout the summer, as well as by other causes, and a repair ship is stationed in Trinity Bay ready for immediate service. The "Minia" is a schooner-rigged steamship carrying three masts, so that sail as well as steam can be employed when under way. The sails, however, are principally utilized in "lying to" when the vessel is making repairs where the water is too deep to permit anchorage. She carries lengths of extra cable coiled in tanks specially built for the purpose, and is provided with a set of steam winches and drums for hoisting and lowering. Her equipment also includes modern grappling appliances, electrical testing outfits, and in addition to the regular crew she carries several expert electricians and cable repairers.

APPROACH TO THE NEW EAST RIVER BRIDGE.

If the carrying capacity of a bridge is the true measure of its size and importance, then the new East River Bridge, now known as the Williamsburg Bridge, is the largest structure of its kind in the world. The length of the river span from tower to tower is 1,600 feet. This is 110 feet less than each of the two great cantilever spans of the railroad bridge across the Firth of Forth, Scotland; but although the Forth Bridge has longer spans and is a much longer bridge from approach to approach, it does not compare in carrying capacity with the new bridge across the East River which is now nearing completion. The Forth Bridge was intended simply to form a railroad connection for a double-track road, and provision is made merely for two lines of track and two footpaths, the total width of the roadway being about 40 feet, whereas the floor system of the Williamsburg Bridge measures 118 feet between the hand rails on the outside of the roadways, and provision is made for four street railway tracks, two elevated tracks, two 18-foot roadways for vehicles, two passenger footways, and two bicycle paths, or in other words the new bridge will have more than the capacity of a great city avenue.

When the bridge was planned some seven or eight years ago, the Bridge Commissioners, profiting by the experience gained with the Brooklyn Bridge, decided not to build any terminal station at each end of the bridge, but rather to consider the bridge as a great connecting thoroughfare between New York and Brooklyn, over which the traffic, elevated, trolley, vehicular, and pedestrian, could pass to and fro without the delays incidental to bridge terminals. Of the various kinds of traffic that will seek the new bridge, only that of the elevated railways will approach it above the normal street level. Surface cars, street vehicle traffic heavy and light, automobiles, bicycles, and pedestrians will enter the bridge approach at street grade. At the center of the bridge the trolley cars and the vehicular traffic will cross the river at an elevation of 140 feet above mean high tide; and both the roadways and the car tracks will rise from street grade at the approaches to the highest point of the bridge at midstream, on the regular grades corresponding to the curvature of the floor system. The foot passengers and the bicyclists will travel on an upper deck of the bridge, built at a sufficient height to clear the roofs of the trolley cars, while the elevated railways will enter the bridge approach at their normal elevation above street grade, and will continue above the approach on a level grade until they meet the rising grade of the bridge floor system, when they will pass over the bridge at the general level of the floor. The position of the various tracks and roadways was shown by this journal very clearly, in an illustrated article published in our issue of June 15, 1901.

Now to bring these various classes of traffic into their proper relative positions on the bridge required careful thought and judicious planning. The view of the bridge shown on the front page of this issue is drawn at a point near the anchorage on the Brooklyn side, and it shows how the traffic is segregated and brought to its proper relative position and level. In the first place, the foot passengers travel over the approach on a single passenger walk located on the center line of the bridge, until near the abutment, when the walk divides and passes to either side of the elevated structure, the traffic toward New York taking the right and that from New York the left of the center. Bicycles and motor vehicles approach the anchorage on a central driveway, located beneath the elevated structure and above the passenger footpath, and at the point shown in our engraving the pathway divides, the bicyclists and motor cyclists bound for New York taking the right-hand of the structure, and the travel from New York coming in on the left-hand side. At the anchorage the footwalk rises to the same level as the bicycle path, and diverges to join the latter, the bicyclists and foot passengers being separated by an iron railing. It will be understood that although at the point chosen for illustration the floor of the elevated structure is located at a considerably higher level than the roadways and trolley tracks, necessitating the use of columns of considerable length, the steep grade of the bridge causes the elevated and trolley tracks to rapidly approach a common level, until ultimately the bicyclists and foot passengers find themselves traveling at a higher elevation than the roofs of the elevated cars.

Our drawing also shows the architectural treatment which has been given to the bridge under the direction of the Municipal Art Commission. It includes the tall finials at the tops of the towers, a softening of the hard lines of the stiffening truss portals, and the provision of the two cut stone shelters above the anchorage. The effect has been to greatly improve the bridge by softening the hard, angular effect which characterized the structure.

Three More Airships for the St. Louis Contest.

Three more airships have been invented and will be entered in the World's Fair aerial tournament to compete for the grand prize of $100,000.

W. M. Morris, a Monte Vista, Col., mining engineer, is one of the contestants. His machine will be 30 feet in diameter and 150 feet long when fully rigged. Aluminium will be the material used in its construction, but no gas bag will be used as in other flying machines.

E. A. Kindler, a Denver, Col., man, has completed a model for an airship and conducted a satisfactory test. He will enter it in the contest for the $100,000 prize at the Fair. Safety appliances are a feature of the airship. Canvas flaps three feet wide extend entirely around the balloon as on Stevens' airship. These are limp except in case of sudden descent, when they open out like umbrellas or parachutes and are large enough to check descent to a gentleness devoid of danger should the gas bags fail completely. Motive power is furnished by a storage battery. The framework, which is made of aluminium and light steel tubing, with the motor, battery and propeller, which is six feet from tip to tip and has four blades, will weigh about three hundred pounds. A test was made recently of the model. The machine is said to have described a circle about fifty feet in diameter, rising, dipping, and finally descending to its moorings without a hitch in its mechanism.

Streator, Ill., will be represented in the aerial tournament by an airship planned by Mr. Reiferscheid, of that town. Reiferscheid's machine consists of a balloon pointed at both ends and lying in a horizontal position. Around this balloon are strips of aluminium strong enough to make a substantial framework. At each end are the propellers, six in all, to be used in raising and lowering the machine and to assist in guiding it. A six horse-power gasoline motor will provide the motive power and the balloon will be filled with hydrogen gas and hermetically sealed. Large fans will provide a safety device which will permit the ship to slowly descend in case the balloon collapses.

The British Antarctic Expedition.

On June 10, Sir Clements Markham, president of the Royal Geographical Society, lectured on the work of the British Antarctic expedition. Although he did not give much information in addition to that which has already been published, he did read a number of private letters containing some valuable data.

It seems that Commander Scott, on his ninety-four-day sledge journey, reached latitude 82 degrees, 17 minutes south, and longitude 163 degrees east, from which it would follow that the eastern coast line of Victoria Land, to which he adhered, extends almost due south of Mount Erebus, his starting point, with only a very slight deflection to the east. A range of mountains extended beyond this point as far as he could see in a southeasterly direction. Scott must have traveled over 980 statute miles on this remarkable journey. His most southerly point was only one mile farther from the South Pole than the corresponding record for the North Pole made by Peary in the Arctic. The "Discovery" was frozen in latitude 77 degrees, 50 minutes, or more than 500 miles further south than any ship ever wintered before. An extensive land mass was found in longitude 152 degrees, 30 minutes west, to which the name of King Edward VII. Land was given. Mountains tower above the land to a height of 2,000 and 3,000 feet above the sea level.

In the other sledge journey, which was undertaken by Armitage, longitude 157 degrees and 25 minutes east and latitude 77 degrees and 21 minutes south was reached. Armitage penetrated Victoria Land almost due west and reached an altitude of 9,000 feet.

An old subscriber, in remitting for renewal of his subscription for the coming fiscal year, writes us humorously, as follows: "A man might get along without his shirt, and could do without the cereals, Force and Oatmeal, but I defy a man to get along without the Scientific American if he wants to fatten his brains to meet men of brains in the common walks of life. Give me the Scientific American, and I will go without my breakfast. Yours always hungry for *top knot* food."

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Engineering Notes.

At the Ormesby Iron Works, Middlesborough (England) an interesting experiment has been in progress during the past twelve months with a blast engine worked direct by furnace gas, and the success achieved has been eminently satisfactory. In order that the gas may be suitable for use in the engine, and to achieve the desired results, it is cooled down so that when it enters the engine its temperature does not exceed 68 deg. F. The gas when passed into the engine must not contain more than 25 grm. of dust per cubic meter. A certain speed of running in conjunction with a certain volume of water is most advantageous, and it would appear that any variation of the one or the other proves disastrous. From the experiments with this engine it has been demonstrated that blast-furnace gas presents no insuperable difficulties for successful employment in large gas engines.

In view of the difficulty experienced by the British Admiralty concerning the storage of steam coal for the navy by the ordinary wharfing, whereby the fuel deteriorates in its calorific value, some important experiments are being made to ascertain whether the coal can be better preserved by storage under water. It is contended that when the steam coal is submerged its calorific quality is preserved. For this purpose five large wooden cases have been constructed; each has been filled with two tons of fresh Welsh steam coal, and sunk in Portsmouth Harbor, where they are to remain in a considerable depth of water for a year. A similar quantity has been stored upon the land in the orthodox manner. At the expiration of the twelve months the coal will be raised and, together with the land-stored coal, will be tested to determine whether the submerged coal has retained its steam-raising capacity better than the land-stored fuel.

The inventors of devices for preventing railway collisions flourish in Germany as well as in the United States. It seems that two German engineers, H. Pfirmann and Dr. M. Wendorf, have invented an apparatus, which underwent a successful trial recently on a specially prepared section of the Sachsenhausen-Goldstein Railway near Frankfurt-on-Main. Dr. Max Wendorf himself supplied the necessary locomotives, and the trial took place on a section of line containing a curve. The principle of the invention is as follows: Along the middle of the track runs an insulated metal rail, which is connected with the locomotive by means of a running contact. In the rail resistances are inserted, and these are overcome as soon as the locomotive approaches another engine, or a signal or crossing, which are also fitted with the same contrivance. If, for example, two engines are traveling toward each other on the same rails, then—and the distance is no object—each engine is immediately electrically connected with the other, a red light is flashed, and a bell is sounded to warn both engine drivers that danger is ahead.

According to the Zeitschrift des Vereins Deutscher Ingenieure, it has been ascertained by Herr Scholter, manager of the Nuremberg-Furth trainways, that the resistance of flywheels is very far from being a negligible quantity. This resistance may be divided into two parts; that exerted by the friction of the air against the rim and that due to the displacement of the air by the arms; the latter being by far the more important of the two. In the central station of the trainway there are two horizontal, tandem compound engines developing 450 horse power at a speed of 95 revolutions per minute. Each has a strong flywheel whose arms are formed of a double T with a central web set parallel to the center line of the shaft. The rotation of these flywheels produces a strong current of air which seemed to indicate the existence of a considerable resistance. The suggestion was made to cover the two faces with a smooth protection of sheet metal, which was done. In order to determine the difference in the resistance under the two conditions, with and without the covering, one dynamo was made to serve as a motor to drive the unloaded engine. With the flywheel in its original condition, the work required was 13,300 watts, while, after the wheel was covered, only 9,874 watts were needed—a difference of 3,426 watts or about 5.7 horse power. The cost is then estimated, which may be reduced to American standards as follows: Considering the engine to be running 17 hours per day for 365 days in the year on a consumption of 2 pounds of coal per horse power hour; the coal burned for the development of the power to overcome flywheel resistance will be about 35 tons, which at $2 per ton will be $70.00 per year. As the cost of covering the flywheels is an insignificant amount, the figures given above may be taken to represent a net annual saving. As long ago as 1888 Prof. Brauer, of Darmstadt, called attention to the advisability of filling in the space between the arms of flywheels and cited an experiment made by Inglis on a 630 horse power engine in which indicator cards showed a saving of 30 horse power or 4.8 per cent due to a reduction of flywheel resistances.

Electrical Notes.

According to the Street Railway Journal, the trolley system is being extended in Rome. The clanging of bells may now be heard in many of the ancient highways formerly trodden by the army of the Senate and the people of Rome. The seven hills of the city have created considerable difficulty in the way of electric railway construction. This has been especially true of the Quirinal hill, which formed a serious barrier between the old part and the new parts of the city. This difficulty has been finally overcome by constructing a tunnel under the Quirinal, upon which is the royal palace. The eastern end of this tunnel commences near the Art Museum on the Via Nazionale, and emerges at a point near the Piazza da Spagna near the Piazza Colonna and the Corso.

The New York Telephone Company has recently put into service a telephone automobile truck which is used in hauling the large reels of covered cable which are placed in the conduits under the surface. These reels are hauled to all parts of the city by this vehicle, but upon being delivered the wagon offers the mechanical means of drawing the cables through the holes. The front end of the truck is fitted with a device made of channel iron, which is sunk into the manhole, affording a rigid support for the pulleys over which the hauling cable runs. The cable drum by which this work is done is located under the driver's seat, and has six speeds varying from 10 to 40 feet of cable per minute. The total weight of the vehicle is 4½ tons, of which 2,800 pounds is battery. With one charge of the batteries, this truck is guaranteed to carry a load of five tons for a distance of 15 miles and to supply the power for placing the wire underground. When the cable-hauling machinery is not to be made use of, the load can be transported a distance of 25 miles. The vehicle has proven to be very economical in service, and does the work of two gangs of men working under the old system.

It is pointed out in Nature that, although the electrochemical equivalent of silver has been the subject of several very careful investigations, the results obtained by different experimenters indicate that the quantity of silver deposited by a given quantity of electricity is dependent to a certain small extent on the form of voltameter and on the conditions under which this is employed. Richards and Heimrod (Zeitschrift für physikalische Chemie) have investigated minutely the cause of these differences, and find that the most important disturbing factor in the ordinary silver voltameter is the formation of a complex silver ion at the anode which diffuses toward the cathode, and by its decomposition increases the quantity of silver deposited at the cathode. An improved form of silver voltameter is described in which the anode and cathode are separated by a porous cell which prevents the diffusion of the anode solution to the cathode, and the accuracy of the results obtained by the use of this instrument is demonstrated by several series of experiments. As a result of this investigation it appears that the electro-chemical equivalent of silver as determined by Lord Rayleigh's voltameter is at least 0.05 per cent too high, and that the quantity of electricity associated with one gramme equivalent must now be taken as 96,580 coulombs.

Owing to the rise in the price of coal during the last few years, M. Thormann, a prominent Swiss engineer, wished to find out whether it would not be an advantage to use electric energy, furnished by hydraulic plants, over the whole of the railroad system of Switzerland. After investigating the subject he published a report which has awakened considerable interest and will no doubt bring about some practical results in this direction. He finds that the substitution of electricity for steam on the railroads is quite practicable and has many advantages, although it will not bring about any considerable reduction in the cost of operating the roads. The five main railroads now existing in Switzerland require over 30,000 horse power daily. In order to organize a complete electric service it will be necessary to obtain about 60,000 horse power in the shape of alternating current of high tension, not counting the reserve supply which is indispensable. Not taking into account the considerable number of falls which are not utilized in the country, there exist already 21 large hydraulic plants which can give a total of 86,000 horse power. These include the plant of Siel, near Linsiedl, which has a capacity of 20,000 horse power, the Laufenburg plant, on the Rhine, giving also 20,000 horse power, then five others giving each 5,000 horse power, etc. He enumerates 21 plants which will be more than sufficient to supply the energy for the Swiss railroads. The cost of changing over the system would of course be considerable and this may be estimated at thirty-two millions, which includes eight millions for rolling stock, fourteen for lines and ten for the various sub-stations. It is to be noted, however, that the adoption of the electric system would have the great advantage of doing away with the present consumption of coal, which is now imported from outside, and that the use of hydraulic energy would be of great benefit in developing several branches of the national industry. The publication of this report aroused considerable attention in different quarters, and already one of the railroad companies has applied to the government for an authorization to use electric trains on a trial stretch of road twelve miles long.

Finances of the Year.

The Treasury department's figures for the fiscal year show that the excess of receipts over expenditures was $52,710,936, which may be compared with $92,000,000 in 1902 and $77,000,000 in 1901. Income was $558,887,526, and outgo $506,176,590. Owing to the repeal of war taxes, the internal revenue receipts were reduced by nearly $42,000,000, but the receipts from customs show a gain of about $29,500,000. This is due chiefly to enlarged imports of materials to be used by manufacturers, and of some finished products which could not be obtained from our own factories without much delay. It indicates activity rather than idleness in our own industries. While the total revenue was less than that of 1902 by $3,500,000, there was an addition of $35,000,000 to the expenditures. Of this increase, $15,000,000 is to be charged to the navy and $6,000,000 to the army. The treasury's available cash balance at the end of the year was $231,415,000 and the total amount of gold in the treasury was $631,639,000, an increase of $71,000,000 in twelve months. At the end of the year the national bank circulation had risen to $413,670,650, the addition for the year amounting to $56,000,000, or nearly 16 per cent. The treasury's figures do not include the revenue ($134,268,000) and the expenditures ($138,885,000) of the Post Office department. Here a deficit of $4,617,000 is disclosed, against $2,961,000 last year.

Important Egyptian Discoveries.

Prof. Flinders Petrie announces some important discoveries made while excavating at Abydos. At a depth of about 20 feet, an old temple site was discovered, in which the ruins of ten successive temples were found, ranging in age from about 500 to about 5,000 B. C. So far as religious discoveries are concerned, it would seem from some relics found that Osiris was not the original god of Abydos. Up to the twelfth dynasty Jackal, god of Vpuaut, and then Khentamenti was honored. About the fourth dynasty the temple was destroyed, only a great hearth of burnt offering remaining, full of votive clay substitutes for sacrifices. This confirms the account given by Herodotus that Cheops had closed the temples and forbidden sacrifices. An ivory statue of Cheops was found, which shows for the first time the face and character of the great builder who made Egyptian civilization what it was for thousands of years after.

The Current Supplement.

Pope Leo XIII. is the subject of the opening article of the current SUPPLEMENT, No. 1437. The events of the great Pontiff's life are narrated fully and accurately. An account is also given of the wonderful Vatican palace, the residence of the Popes. A machine for carving wood moldings is described. Mr. A. E. Potter tells something of interest about marine engines. An article on self-igniting devices for coal-gas should not be without value. Opticians will find of interest a discussion of the aberration of the sphericity of the eye. In an excellent article by the Paris Correspondent of the SCIENTIFIC AMERICAN, the famous Serpollet racers are analyzed. Mr. James Alexander Smith tells how a circular computing scale can be simply made. Dr. Fleming continues his admirable explanation of Hertzian Wave Telegraphy.

Most of the experiments made with X-rays, whether in connection with the germination of seeds, heliotropism, or chlorophyl formation, have failed to yield positive or satisfactory results. Circulating protoplasm, however, seems to be sensitive to the effect of X-rays, and, as H. Seckt has shown, the movement is hastened and prolonged thereby. The protoplasm of isolated hairs of *Cucurbita pepo* and *Tradescantia virginica* showing sluggish movement quickened under the influence of X-rays. A positive result was also obtained with *Mimosa pudica*; at a distance of about one foot from the tube the leaves began to close after being subjected to the rays for twenty minutes. In the most favorable cases the closing of the leaves could be followed from the youngest to the oldest, and the fall of the petiole ensued in due course.—Berichte der Deutschen Bot. Gesellschaft.

The Patent Office's work during the past year has been in every way remarkable. The number of patents issued amounted to 29,329, whereas last year's patents numbered only 26,031. The trade marks registered show an increase from 1,864 to 2,194. The recent court decisions, which hold that designs are to be restricted exclusively to ornamental things, have resulted in a decrease in the number of design patents granted.

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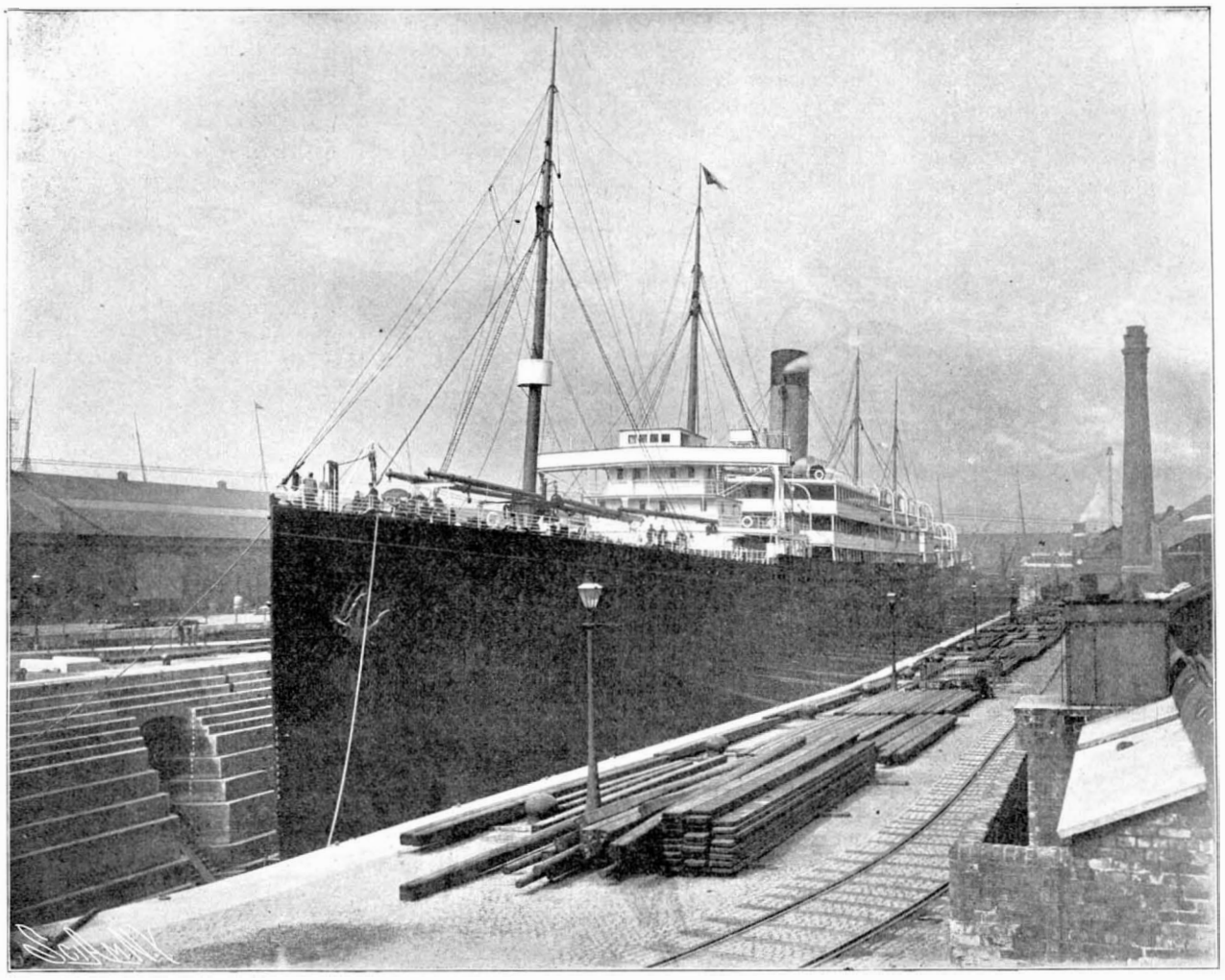
THE NEW LINER "ARABIC."

A notable addition to the fleet of great Atlantic passenger and cargo steamers is the "Arabic" of the International Mercantile Marine Company's White Star Line. The "Arabic" sailed from Liverpool on her maiden voyage on June 26, and reached New York after a passage of a little over seven days. The accompanying excellent photograph of the new steamship was made while she was in drydock at Liverpool shortly before starting on her first voyage. The "Arabic" is a representative of the type of Atlantic liner that seems to be becoming especially popular and profitable. In general her lines are like those of her giant sisters, the "Celtic" and "Cedric." She is excelled in size by these two vessels, which are of 20,000 and 21,000 tons respectively, by the 17,000-ton "Oceanic" of the same line and by two or three of the swift German liners, but aside from these she is larger than any other vessel in the Atlantic trade. Her gross tonnage is 15,300; her length is 600 feet, her beam 65 feet, her depth 44 feet, and her cargo capacity 16,500 tons. In the design of the "Arabic" no effort toward attaining extreme speed was made. She was designed to make 16 knots, but on this her maiden trip she averaged over 17 knots for 24 hours, and was well over her contract speed for the whole voyage. She is equipped with twin-screws and two sets of quadruple-expansion engines of 10,000 horse power, and with her great cargo capacity is expected to be an exceptionally steady vessel. Her owners say that her engine power is ample to enable her to keep to her schedule requirements with thorough regularity. Her quadruple-expansion engines are arranged on the balance principle, and the vibration was scarcely noticeable. In the minor features of her construction and equipment the "Arabic" embodies a number of new and improved features. She carries a very complete electric plant; her cabin staterooms are warmed by electric heaters, and she is ventilated throughout by electrically-driven fans. The very roomy staterooms, which are a conspicuous feature of the "Cedric" and "Celtic," are duplicated in the "Arabic." She has a continuous shade deck fore and aft, with three tiers of deck houses and two promenade decks above them. The first-class dining saloon is on the upper deck, and all the first-class accommodations are amidships. The second-class passengers—to whom more and more attention is being given in successive new Atlantic liners—have their quarters immediately aft of the first-class. The third-class passengers are provided for aft of the second-class, while there are also some third-class accommodations forward. Perhaps it is in the quarters assigned to third-class passengers that the greatest innovations are noticeable. When the reconstructed White Star liner "Majestic" returned to the Liverpool - New York service recently after an absence of more than a year, visitors who inspected her remarked that her third-class accommodations would have been a revelation of luxury to second-class travelers of no more than a decade ago. The "Majestic's" quarters were remodeled after those of the new "Arabic." There are no open berths in the steerage, or third-class as it is now called, but the space is divided into two, three, and four-berth rooms, all thoroughly ventilated and kept as clean and well painted as the first-cabin quarters. The third-class passengers have a comfortable dining saloon, in which the tables are fitted with revolving chairs quite after the accepted cabin fashion.



Length, 600 feet; breadth, 65 feet; depth, 44 feet; cargo capacity, 16,500 tons; horse power, 10,000; speed, 17 knots.

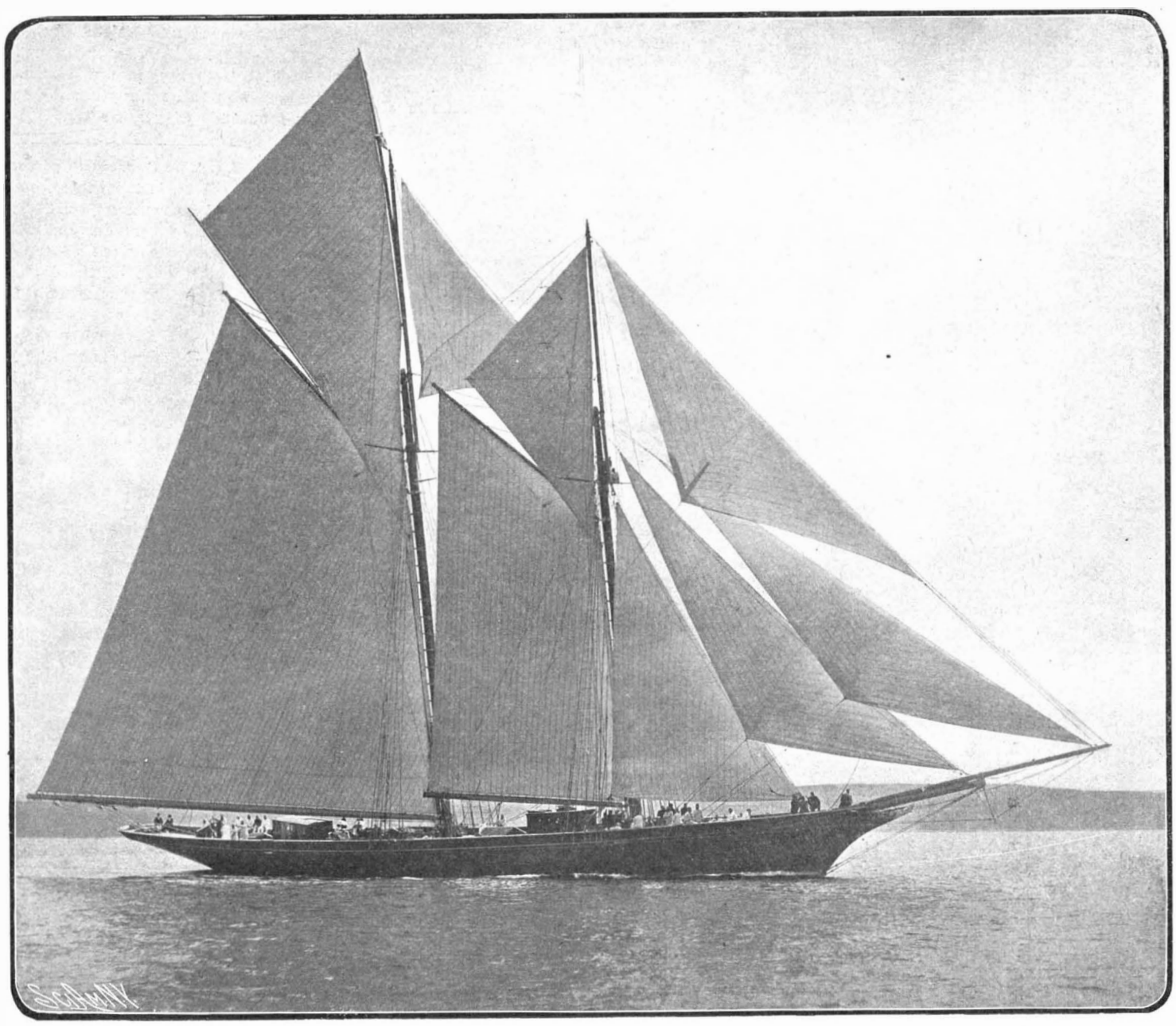
THE NEW WHITE STAR LINER "ARABIC."

While the "Arabic" presents no striking departures in construction and equipment from her successful prototypes, the "Cedric" and "Celtic," she represents the steady advance in the direction of comfort, steadiness, and moderate speed which seems to be the trend of the times in big passenger ships. Like the other White Star ships, the "Arabic" was built in the Harland & Wolff yards at Belfast.

THE "GLENIFFER."

BY OUR GLASGOW CORRESPONDENT.

Generally speaking, when a yacht owner or prospective owner sets out to break any of the designing or building records, he starts with a clear idea of what the appearance of the vessel is likely to be and with



Length on deck, 187 feet 6 inches; on waterline, 141 feet. Beam, 27 feet. Draught, 17 feet. Length from tip of boom to tip of bowsprit, 224 feet. Height from water to top of maintopmast, 141 feet.

"GLENIFFER," THE LARGEST AND FASTEST FORE-AND-AFT SAILING YACHT EVER BUILT. AVERAGE SPEED RECORDED FOR 100 KNOTS, WHEN REACHING, 16 KNOTS PER HOUR.

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Fig. 1.—The Beer-Tap.

Fig. 2.—General View of the Automatic Restaurant.

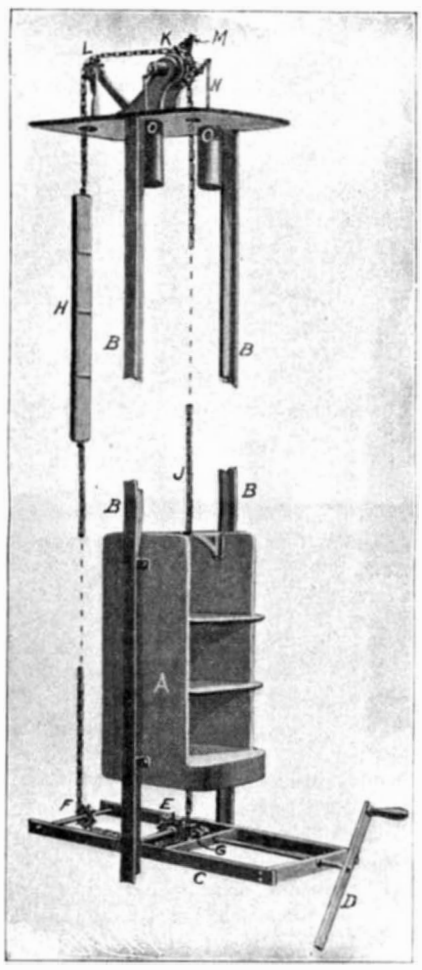

Fig. 3.—Details of the Elevator.

Fig. 4.—Buying a Cup of Coffee.

Fig. 5.—Removing a Purchased Dish.

Fig. 6.—A Kummel Cask.

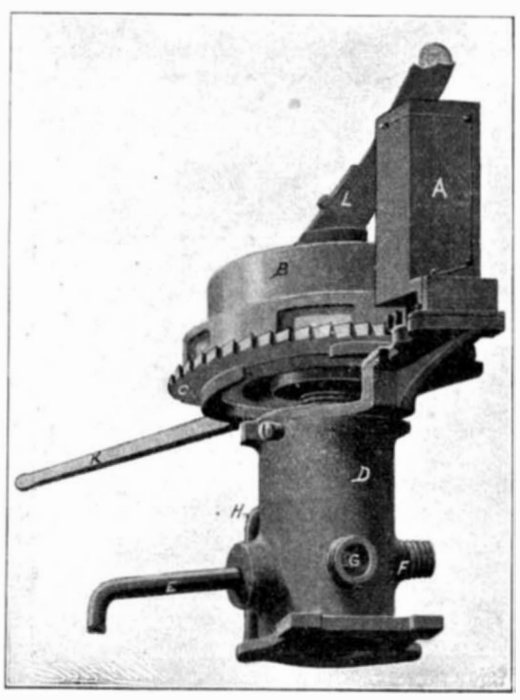

Fig. 7.—Details of the Automatic Valve.

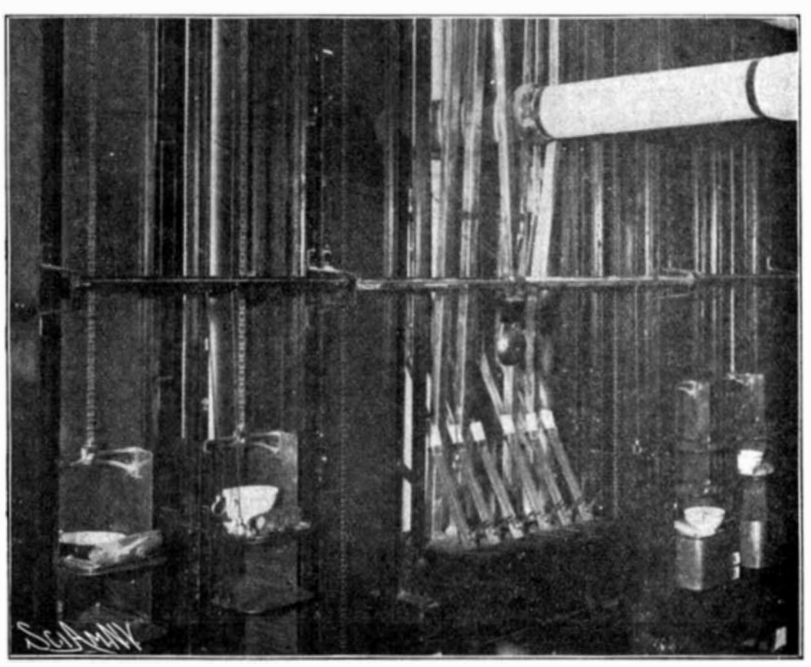

Fig. 8.—The Elevator and Coin Chutes.

THE AUTOMATIC RESTAURANT.—[See next page.]

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at least some idea of the figure to which the cost of the contract is likely to run. The building of the schooner yacht "Gleniffer," the largest two-masted schooner ever built purely for pleasure, was, however, undertaken in a different fashion. Her owner, Mr. James Coats, Jr., of Ferguslie, Paisley, Scotland, takes his yachting on rather original lines. He has done much to further the nautical sport in Scotland, and something for the cause of international sport, for he was owner of the 10-tonner "Madge," the most successful British boat ever sailed in American waters. It is one of his peculiarities that he never sells a boat, and the result is that notwithstanding the generous manner in which he has presented steam and sailing yachts to many relatives and friends, he still stands in possession of over a dozen yachts, steam and sail. Next to the "Madge," which was laid up in America and allowed to rot after a phenomenally successful career, his best known boat was the cutter "Marjorie," which played a prominent part in British yachting twenty years ago. "Marjorie" was gradually outclassed, and when Mr. Coats decided to build again, he had lost his keen zest for racing and decided to procure a craft in which he could enjoy the maximum of comfort when cruising.

He figured out therefore the amount of accommodation which he required aboard, and commissioned Mr. George L. Watson to build him a boat which would provide it. So generous were his ideas in this direction, that the natural method of meeting them would have been to build one of the large steam yachts in which our millionaires now seek pastime. Mr. Coats is, however, old-fashioned enough to cherish a deeply-rooted distaste for the steamship, and his orders were that the new vessel should be canvas-driven. The fact that the building of a shapely hull round the generous accommodation which he had sketched would produce the largest sailing yacht ever built did not alter his plans, and the result was the production of the schooner "Gleniffer," which has been for some time the most notable yacht of the whole Clyde fleet.

The 90-footers built for "America" Cup racing are generally considered as going to the limit in sailing yachts, but these fall a long way short of the dimensions of this magnificent schooner. From figurehead to taffrail "Gleniffer" measures 187½ feet, over 50 feet longer than "Columbia." The beam of the schooner is 27 feet, and her draught 17 feet, while her measurement by the Thames rule works out at about 450 tons. It is in displacement that her extra bulk as compared to the Cup racers is specially apparent, for while the cutters are severely undercut below water, "Gleniffer" is comparatively long-keeled and deep-bodied—the very ideal of a vessel intended for cruising.

In general outline and in section, the yacht has a striking resemblance to the "Thistle," which was sent across the Atlantic in 1887 to race for the "America" Cup. The profile forward is almost identical, for in designing it Mr. Watson abandoned the modern spoon bow and went back to the more graceful clipper or swan-neck bow of ten or a dozen years ago. Above the water the stem shows distinctly hollow, but about the water-line it sweeps into a convex curve which is carried down into the lower keel plates. From the end of this curve the keel runs with little or no increase of draught back to the heel of the sternpost. The sternpost is less raked than has been the rule in recent productions, and it cuts at top through a fairly long and very graceful counter, which rises with a good deal of spring and gives an overhang aft of about 27 feet. The forward overhang measures about 16½ feet.

One hundred and fifty tons of lead is required as ballast to steady her against her enormous spread of sail, and this is carried inside, most of it being in one solid ingot. Compared with the yachts of modern design she looks high in the topsides, but this is accounted for by the fact that instead of the usual apology for a rail her decks are set round with a serviceable gunwale 2 feet 6 inches high. The deck has been kept as clear as possible, and is broken only by a small smoking lounge at the galley, which is situated amidships.

In the construction of the yacht nothing has been sacrificed for lightness or speed. The materials are all of the best procurable, and the scantlings are in every case in excess of what are demanded for the highest class at Lloyds. Under water the plates are overlapped and riveted in the usual way with a double row of rivets, but in the topsides the plates are butted and strapped inside, leaving a beautifully smooth surface. The elaborate scale upon which the fittings below are carried out gives the best possible proof that the yacht was designed primarily for comfort and convenience in cruising, and one advantage of the sailing yacht is shown in the fact that the "Gleniffer" has more spacious cabins and better accommodation than many steam yachts two or three times her size. A passage 3 feet 6 inches wide leads from the companion to the main saloon, a large and airy apartment which extends the whole breadth of the yacht amidships, and is so designed that it may be divided by curtains into dining and drawing cabins or used as one big saloon. Abaft of this, on the starboard side, are the owner's private apartments, consisting of library, sleeping cabin, and bathroom, all of these being airy, well-lit cabins of about ten feet square with seven feet of headroom throughout. Opposite these on the port side are guests' cabins, planned in somewhat similar style, and consisting of four cabins with bathrooms, cloakrooms and smokeroom adjoining. Aft of these again are two ladies' cabins, handsomely fitted and provided with everything necessary for the comfort of lady guests.

Forward of the main saloon are the officers' quarters—a snug little cabin for the skipper, and three others which give accommodation for the half dozen officers who assist in the command. Alongside these are the steward's pantry and storeroom, which communicate by means of a small hoist with the galley on deck.

The crew of thirty-four men is excellently housed in a commodious and airy forecastle. Under the cabin floor is a lower deck running the whole length of the vessel, with about five feet of headroom. Sails and all the lighter stores are carried here, while water and oil tanks, cables and heavier stores are carried under this again.

As might be anticipated from her great length and sail spread of 18,000 square feet, the "Gleniffer" has made some exceptionally fast passages when going free. Once, off the east coast of Ireland, she logged 16 knots an hour over a measured course of 100 miles from light to light; and last year under similar conditions off the Hebrides she made the same speed over a slightly shorter distance. This pace is probably the greatest ever attained by any ship carrying full sail in a moderate breeze.

THE AUTOMATIC RESTAURANT.

We have slot machines that sell us candy and chewing gum, slot machines that sell collar buttons, slot machines by which we can be weighed, and slot machines which set a phonograph or music-box in motion and soothe us with the latest popular airs while we wait in the railway station or ferry house. Now we have the automatic restaurant, a gigantic slot machine or combination of slot machines from which we can purchase food and drink.

To the American, who is now so accustomed to mechanical contrivances that he no longer is astonished by their performances, this automatic restaurant is but the logical development of the automatic vending machine. The wonder is that this idea is not of American, but of German, origin. Automatic restaurants have been a familiar sight in many of the more prominent European cities for the last nine years.

New York's restaurant, in principle, is very much the same as those of the German towns. It is fitted up much more elaborately, however. Its electric lights, its dazzling mirrors, and its resplendent marble outshine everything on Broadway. The average café which to the country visitor seems to be illuminated with extravagant splendor, is but a dismal place compared with it.

The man who walks into the automatic restaurant with the idea that he can sit down at a table and order what he likes from a waiter, will be sadly mistaken. There are no waiters in the usually accepted sense of that term. The two or three white-aproned men who nonchalantly roam around without apparently much to do are there not to serve meals, but to remove the empty dishes. You must serve yourself. You buy your portion of meat or soup, your glass of beer or wine, or your cup of coffee, and you carry what you have bought to your table. If you are in a hurry, you may stand and eat, and enjoy what is popularly known as a "perpendicular meal."

In describing the automatic restaurant, it may be well to divide its various appliances into three classes. The first class of machines sell hot food by means of coins and checks; the second dispense cold food (salads, desserts) by the use of coins alone; and the third sell liquids (beer, wine, coffee, whisky, liquors, etc.) by the use of coins alone.

The restaurant comprises two floors, or rather a floor and a basement. On the upper floor the patrons purchase what they desire; in the basement the food is cooked or otherwise prepared, and lifted to the floor above by means of elevators.

The operation of the elevators may best be explained by describing the process of purchasing food. The bill of fare is printed upon a board in which the slots are located. Each slot bears a reference letter. Opposite slot *A*, a small placard is pasted which gives the name of the particular dish to be purchased by dropping a coin in that slot. Similar legends are printed upon the placards pasted opposite slots *B*, *C*, *D*, etc.

After the desired dish has been selected, a coin of the proper denomination is dropped into the corresponding slot. A handle is pulled, which rings a bell in the basement, and signals the attendants. Simultaneously a brass check is delivered. The coin has dropped down a chute, which lies adjacent to the elevator and is held in place at the bottom by a retaining device. By counting the number of coins as they lie side by side above the retaining device, the attendants know exactly how many dishes of that particular food are wanted. As each dish is served, the retaining device is released, so that a coin drops into a receptacle, leaving behind a number of coins corresponding to the number of dishes still to be served. The food, attractively served in neat chinaware, is placed on a silvered metal tray in one of the compartments of the elevator *A* (Fig. 3). The shaft of the crank *D* is rotated, and carries at its end a bevel gear *G* meshing with the bevel gear *E*. The shaft upon which the gear *E* is carried is provided with a sprocket wheel about which a chain *J* passes, which meshes with the sprocket *F* in the frame *C*, carrying the crank shaft, and likewise with the sprockets *L* and *K* in a frame at the upper end of the elevator. A counterweight *H* facilitates the raising and lowering of the elevator. After the silver tray has been placed in one of the compartments of the elevator *A*, the crank *D* is turned in order to raise the elevator to the floor above. The purchaser sees his dish as it lies in the elevator behind a glass partition; he cannot reach it, however, because it has been lifted somewhat above the discharge opening. Not until he has dropped his brass check into a second slot, bearing a reference letter corresponding to that of the coin slot, and pulled another handle, will the elevator descend sufficiently to enable him to obtain his purchase. After the elevator has descended, the food is removed in the manner shown in Fig. 5.

Here, one peculiarity in the slot mechanism of the automatic restaurant should be mentioned. Spurious coins, as well as coins of improper value, fail to operate the mechanism. An honest slot machine is probably as rare as an honest man. The automatic restaurant machines, however, are far more trustworthy than many a human being. Coins of improper value which have been erroneously inserted are returned. The purchaser is not cheated.

Cold foods, such as salads and desserts, are placed upon the elevators of another section and raised to the purchasing floor in full view, protected, of course, by glass partitions. In order to purchase what one desires, it is necessary simply to drop a coin in the slot and to pull a handle. The elevator then descends one step so that the particular salad or dessert can be withdrawn from the discharge opening just as in the previous case. No checks are here used, since the dishes are cold and the attendants below need not be informed of the particular kind of food desired.

The liquor-dispensing machines have for their most interesting feature a self-measuring valve by means of which an amount of liquor is dispensed which is the exact equivalent in quantity of the value of the money received. It is rather curious to observe that for a five-cent piece a glass of beer—no more and no less—runs out of the faucet. Kümmel, Bénédictine, and other liqueurs are sold with like mechanical accuracy. The glasses are brimful; not a drop too much trickles out of the cask.

When a beer-cask is nearly emptied, a bell is automatically rung to call the attention of the attendants in the basement to its condition.

In Fig. 7, a general view of the automatic valve is presented. *A* is a box which contains registering mechanism, from the dial of which can be immediately ascertained exactly how many cups of coffee, glasses of beer, wine, whisky, or soda-water, as the case may be, have been sold by the particular machine in question. *B* is a money-chamber into which a coin drops after it has fallen through the chute *L*. *C* is a gear-wheel which meshes with a pinion operating the registering mechanism contained in the box *A*. As the gear wheel *C* is moved in response to the movement of the lever *K*, the registering mechanism in the box *A* will be actuated. *D* is a cylinder within which is a cone containing exactly the measure of the liquid to be sold. *H* is a drain-pipe from the cone. By operating the lever *K*, which is released as the coin enters the money chamber *B*, the cone is turned so that an opening with which it is provided may register with the outlet-pipe *E*, in order that the liquid may be discharged. *F* is the feed pipe.

How a glass of beer is bought is best shown in Fig. 1. The glasses are all hung on pegs on a marble panel above the slots. The purchaser removes one of these glasses, rinses it, if he likes, in an automatic sprinkling device especially provided for that purpose, places it beneath the tap, and puts his coin in the slot. He pulls the lever over, as far as it will go, and allows it to fly back. The beer flows out of the tap into his glass in just the right quantity.

The valve by which coffee is dispensed is exactly of similar construction; the cups, however, are disposed not on pegs, but in elevators similar to those by which food is raised. The coffee is kept hot by means of a vessel containing water, within which the coffee tank itself is contained.

The method of buying liquors or wine or soda-water is precisely the same as that which we have described in connection with the purchase of beer.

New York is by no means the first American city to

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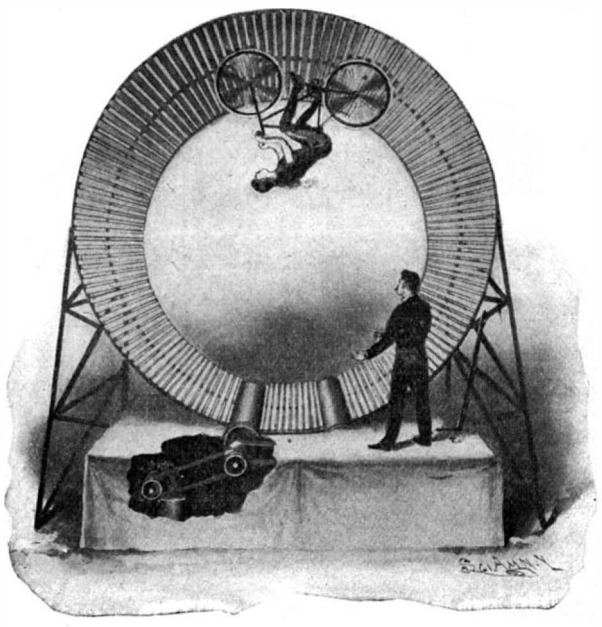
possess an automatic restaurant. Philadelphia anticipated it by some months. The Philadelphia equipment is exactly similar, mechanically, to that of New York. Restaurants on the same principle are soon to be opened in Chicago and the leading American cities.

The Pioneer American Manufacturer of Steel.

A contract made by Cornelius Atherton, the pioneer steel maker of the United States, was recently found among the effects of Cornelius Atherton, Jr., who died about twenty years ago at Afton, N. Y. The document, which bears the date of 1772, was found by W. M. Atherton, of Chicago, a descendant of the famous steel maker. It appears in the contract that Atherton agreed to "learn and instruct James and Ezra Reed in the art of making steel." The document was attested by Thomas Barlow, of Kent, Litchfield County, Conn., and Thomas Delano, the great-uncle of Columbus Delano, Secretary of the Interior in Grant's cabinet.



A COMBINED CYCLE-WHIRL AND LOOP-THE-LOOP.

Cornelius Atherton was born in Cambridge, Mass., 1736. In 1763 he became connected with the Dover Iron Works. Associating himself with John and Samuel Adams and John Hancock, he began the manufacture of firearms and cutlery in Boston in the year 1769. After the works were burned down, presumably by the British soldiers, Atherton went to Pennsylvania, becoming one of the founders of the city of Scranton. At that time Scranton was called Slocumb Hollow. Mr. Atherton died at Afton December 4, 1809.

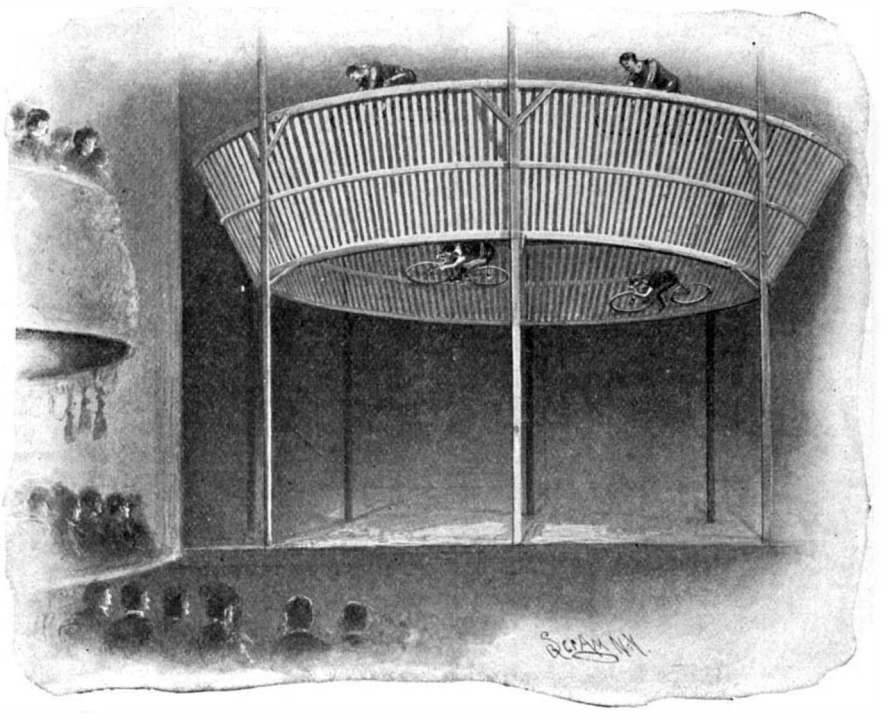
The total gold production of the world from the discovery of America by Columbus to the year 1900 is, according to the report of the United States Mint, in round numbers, $9,811,000,000. Pure gold of this value would weigh about 16,272 tons, and occupy a space equal to 27,039 cubic feet. Graphically this amount could be represented by a solid circular tower of gold 20 feet in diameter, and 86 feet high. The total yearly world production of gold since 1900 would increase the height of such tower about 3 feet each year.

SOME FREAK CYCLE-WHIRLS AND LOOP-THE-LOOPS.

The Théatre du Moulin-Rouge of Paris has its "Circle of Death," and the Folies-Bergère has its "Terrible Ring." Both are what may be called "aerial velodromes." The track of the former is a kind of bottomless saucer or truncated cone, composed of laths, separated by a space of 2 to 2½ inches. The walls are inclined at an angle of about 70 degrees. Through the laths it is possible to see everything that passes within. This aerial velodrome measures about 22 feet in diameter at its middle. The track itself is about 7 feet wide. By means of steel suspending wires, the ends of which are wrapped about windlasses, it is possible to raise and lower the track. The most astonishing evolutions are performed when the track is raised about 16 feet from the stage.

Dan Canary's "Circle of Death," exhibited at Madison Square Garden, New York city, is still more complicated. The bicyclist mounts by a long helical spiral until he reaches the circle itself, situated at a height of 60 feet above the ground. In order to emerge from the circle, the bicyclist ascends to the edge of the ring and enters a path which plunges down at a frightful incline.

Perhaps the record for tricks of this kind belongs to Miss Lottie Brandon, who seems to have done things in New York, compared with which the feats of the men who ride through the "Looping-the-Loop" apparatus and the "Circle of Death" seem tame. The track is vertical. In order to acquire the necessary momentum, speed is gotten up on a pair of rollers journaled in the lower part of the circle. When a sufficiently high speed has been attained, the rollers are dropped by an arrangement of levers, and the bicyclist whirls around the circle, which measures about 16 feet in diameter. To stop the bicycle is a more difficult task than to start it. On the descent, a powerful brake is applied, so that the speed is considerably reduced, in order to enable the performer's manager to snatch her from the wheel as she comes dashing down. The wheel itself is carried on by the momentum.—Translated for the SCIENTIFIC AMERICAN from La Nature.



THE ELEVATED BOTTOMLESS CYCLE WHIRL.

American-Made Heathen Idols.

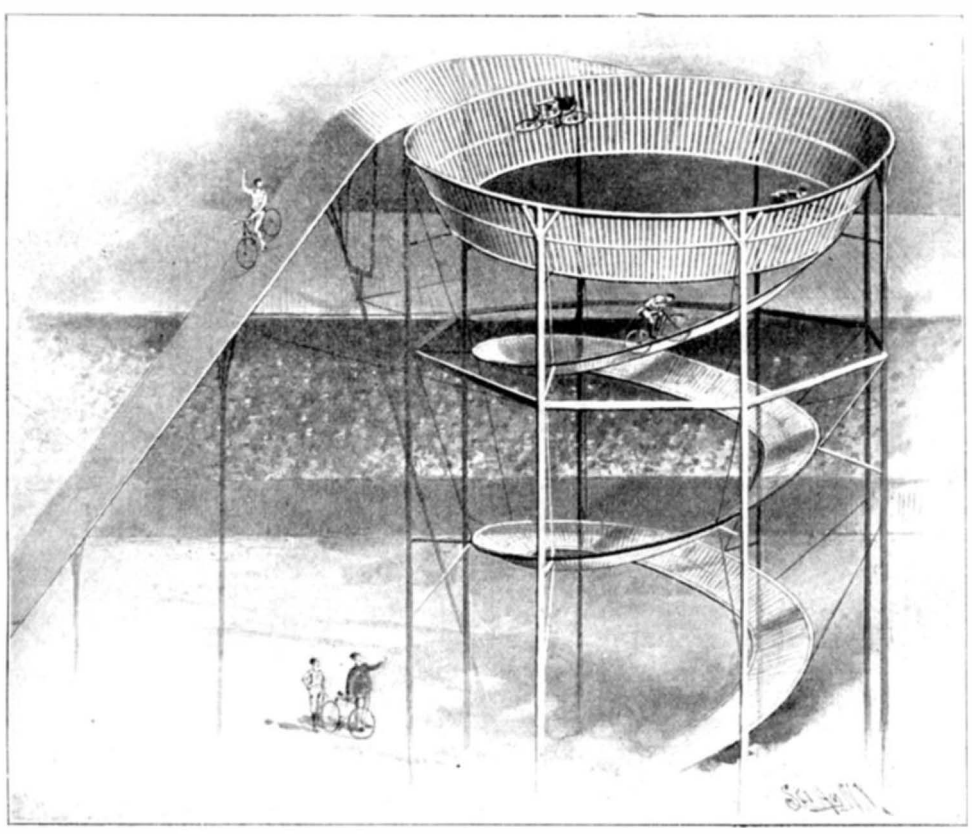
It is not very generally known that Philadelphia is one of the sources of supply whence the Far East derives the idols which it worships. Philadelphia, however, is not the only occidental city in the world which has a plant for the manufacture of graven images. In Germany thousands of idols are turned out each year; and many a little god and fetich, worshiped by the African savage, comes from the enterprising manufacturing town of Birmingham, England. Mr. F. Poole, a Philadelphia missionary, has made the sorrowful discovery that the Christian nations who are so very desirous of converting the benighted idol-worshiper of the East, furnish a goodly percentage of the wooden figures which are the direct means of continuing the very religions that missionaries seek to destroy.

The Philadelphia idol factory, to which we have referred, is conducted by a German. His chief market is India, largely for the reason that the figures which he turns out are Buddhas and Ganesas. In this factory, Buddhas of all sizes and of all materials are made, to be sold at all prices. A white marble Buddha is considered a rather expensive god. His value can be gaged by the foot, for it seems that his price is $50 when his height is two feet. That the models must be accurate goes without saying, for the devotee of India must have all details traditionally exact. The Buddhas are made after an exact copy of a Siamese Buddha reputed to be the best image of the god extant.

The god Ganesa, whose four arms and elephant's head are familiar to the student of Indian mythology, is no less a costly personage than Buddha himself. The commercial value of Ganesas varies. Plain and undecorated Ganesas can be had for $50. If the divine dignity be heightened by ornament, the god may fetch as much as $75. Like the Buddhas, the statues of Ganesa are copied slavishly from an accurate model; for every band, every color, every little decoration, has some symbolic meaning. A bit of color slightly inaccurate in shade, or an ornament improperly placed, may render the most picturesquely hideous Ganesa or Buddha absolutely worthless to a Hindoo.

The little wooden gods which are sold to the poor, although made with like minute attention to details, are not so elaborately embellished. The disciple of Ruskin will probably feel incensed to learn that not only are the gods made in the factory of an occidental to whom they have no artistic meaning, but that they are even made by automatic machines. But what is worse, the cheap machine-made idols are given away by the Secretariat of Korean temples to each worshiper who deposits at the gate a piece of money, in accordance with the time-honored custom of Buddhists.

In justice to the missionaries, be it said that they are bitterly opposed to this traffic in idols. But the German Philadelphian (or Philadelphian German, if that term be preferred), despite all protests, continues to carry on his business.



THE "CIRCLE OF DEATH."

Commercial Utilization of Producer Gas.

According to Mr. H. A. Humphrey, of London, who has closely investigated the problem of the possible application of producer gas to industry, if producer gas were generally introduced to replace direct firing by coal in all cases where gas firing is applicable, the saving in the consumption of fuel would amount to at least one-half of the total quantity now used. The gas producer is an apparatus for the conversion of the whole of the combustible matter obtained in the coal into a combustible gas, no coke residue even resulting—only ashes which it is impossible to burn remaining in the producer. Essentially the gas producer is a closed vessel containing a deep bed of incandescent fuel, through which air or air and steam is blown, and in which partial combustion of the coal takes place. The amount of coal actually burnt in the producer is, however, the minimum necessary to generate the heat required for decomposing the coal and some of the steam, and converting them into an inflammable gas, containing hydrogen, carbon monoxide, and methane gas as the combustible constituents, and carbon dioxide and nitrogen as the non-combustible constituents. In retorts for producing illuminating gas a ton of coal yields about 10,000 cubic feet of lighting gas; but from each ton of coal consumed in the gas-producer about 150,000 cubic feet of producer gas is obtainable. Although the calorific value of the lighting gas is nearly four times that of the same volume of producer gas, the quantity of the latter available is so much greater that the total available heat units in the producer gas are practically four times as great as with lighting gas derived from the same weight of fuel.

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RECENTLY PATENTED INVENTIONS.

Electrical Devices.

CLIP.—L. STEINBERGER, Brooklyn, N. Y. This clip belongs to that kind used for suspending wires, cables, and other electric conductors. The invention relates more particularly to the production of a cheap, simple, and efficient clip, which may be placed at any desired angle relatively to the hanger-wires and owing to the locking device may be secured in a permanent and reliable manner.

TROLLEY.—J. H. WALKER, Lexington, Ky. In the present case the invention is an improvement in trolleys, and particularly in the means for supporting the wheel and lubricating it. Means are provided to avoid the formation of arcs which operate to rapidly destroy the wheels in the ordinary construction. There are means for holding the trolley-wheel firmly in line to prevent tilting to either side. Contact is made at the ends of the journal or axle carrying the wheel without extra contact-springs, and the contact is held positively at all times at the ends of the journal.

Mr. Walker has also invented another improvement in trolleys. It has for an object, among others, to provide novel means whereby to support the trolley-wheel, to prevent the wire from dropping immediately alongside the wheel, and for securing a more effective conduction of the current from the wheel and along the pole.

Household Utilities.

HOSE ATTACHMENT.—W. G. MCKAY, Leadville, Col. To prevent water and dirt collecting around a hose and to enable this article to be moved with greater ease, the inventor provides an attachable support, any number of which may be applied to the hose to raise it from the floor or from the ground in case of use on a lawn or the like. The attachment also prevents splinters or the like from injuring the hose and enables the latter to dry more quickly, thus tending to preserve it.

WASHTUB.—G. V. BLACKSTONE, Jamestown, N. Y. The aim of this invention is to provide certain new and useful improvements in washtubs whereby the tub is greatly strengthened and the legs securely held in position on the tub-body to insure a firm standing of the washing-machine on the floor, and at the same time relieving the lower hoop of a portion of the strain incident to the swelling of the bottom of the tub.

FLOUR-SIFTER.—G. W. HANCOCK, Lynchburg, Va. The aim of this inventor is to furnish a manually-operated device adapted to sift flour, meal or other powdered substances faster and with more ease and cleanliness than can be done by the old-style wood or tin rimmed sifters. Means are provided to prevent dirt, bugs, worms, weevils, etc., from being pressed or ground through the meshes of the sieve.

BED-COVER HOLDER.—F. C. BILLINGS, Macon, Mo. This invention relates to clamping devices such as shown in a former patent granted to Mr. Billings; and the object is to provide a bed-cover holder cheap to manufacture, easily applied and designed for holding the coverings securely in position and to allow convenient opening of the holder for removal of the covering.

Miscellaneous.

DISPLAY-TRAY.—J. H. SMITH, Brooklyn, N. Y. The present invention refers to store-furniture; and its object is to furnish a new and improved display-tray more especially designed for containing and neatly displaying hosiery and like articles and arranged to hold different sizes of an article of a certain price.

RIFLE-RANGE.—J. DE ST. LEGIER and E. HERBAGE, Hicksville, N. Y. The purpose of this invention is to provide a target-box so constructed that it will be quickly freed from smoke and to so construct the sight tube that the smoke will pass out therefrom almost simultaneously with the explosion, enabling the marksman to plainly read the target immediately after firing. Means are provided to coat, paint or clean the target after each shot, and to illuminate or darken a bull's-eye.

TRIPOD.—W. F. FOLMER, New York, N. Y. This tripod is especially designed for use with cameras, but it may be employed wherever a tripod is necessary. It is so constructed that the legs while pivotally connected with the head, preferably in a detached manner, can be quickly and rapidly spread apart and locked to the head, remaining until purposely released. The tripod is easily folded or reduced in length for storage or transportation.

SUBCALIBER FIREARM.—G. H. GARRISON, Rockford, Ill. The claim of the inventor of this firearm is, that he provides an attachment or auxiliary means adapted to be placed in the breech of standard-gage rifles in order to make the arm available for use in discharging cartridges of smaller caliber. An insertible subcaliber device is equipped with means arranged to receive the impact of the center-fire firing-pin of the main rifle and to transmit the force to the rim of a subcaliber cartridge. Means are provided to readily extract exploded shells.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

THE IDEAL LAWN MOWER GRINDER.

This is an article which is as novel as it is useful. It needs no practical specialist. And the sharpening can be done in a fraction of the time formerly required.

The mower is placed upside down on two horizontal adjustable iron bars, the blade fastened to the emery wheel by a little clamp on its side, and by turning the crank now, the emery is made to revolve and slide along the lower shaft from left to right, taking out, in less than a minute per blade, every inaccuracy, making the bevel exactly uniform. The knife bar can be sharpened in the same way. The machine is guaranteed to do all that is claimed for it as above, and can also be used for grinding chisels, plane bits, etc. Its cost is $18 and it is manufactured by the Root Bros. Co., Plymouth, Ohio.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 4380.—For contractors to drive concrete piles,

AUTOS.—Duryea Power Co., Reading, Pa.

Inquiry No. 4381.—For a small steam turbine for laboratory use.

Morgan Emery Wheels. Box 517, Stroudsburg, Pa.

Inquiry No. 4382.—For an up-to-date dividing engine.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 4383.—For makers of machinery and fixtures used in making glass, bottles, etc.

Blowers and exhausters. Exeter Machine Works, Exeter, N. H.

Inquiry No. 4384.—For manufacturers of small brass cannon fired by percussion caps.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 4385.—For dealers in novelties, sea shells, beads and rolled plaited wire.

Mechanics' Tools and materials. Net price catalogue. Geo. S. Comstock, Mechanicsburg, Pa.

Inquiry No. 4386.—For manufacturers of electric plows.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 4387.—For a machine for counting and folding sheets of manila paper.

We make novelties in all kinds of metals. Any quantities. Metal Stamping Co., Niagara Falls, N. Y.

Inquiry No. 4388.—For manufacturers of fancy wood for inlaying purposes.

Let me sell your patent. I have buyers waiting. Charles A. Scott, Granite Building, Rochester, N. Y.

Inquiry No. 4389.—For the manufacturers of the Spalding water motor.

Bargain, 300,000 feet seamless steel tubing, 5-16 to 2 inches diameter. The Cleveland Distributing Co., Cleveland, O.

Inquiry No. 4390.—For spring motor or cheap motive power for propelling a typesetting machine.

For Machine Tools of every description and for Experimental Work call upon Garvin's, 149 Varick, cor. Spring Streets, N. Y.

Inquiry No. 4391.—For makers of mail order novelties and specialties.

We have a market for all sorts of novelties and useful articles. Send circulars and quantity price. Keokuk Novelty Co., Keokuk, Ia.

Inquiry No. 4392.—For the makers of the "Shortts Duplex High Speed Engine."

Crude oil burners for heating and cooking. Simple, efficient and cheap. Fully guaranteed. C. F. Jenkins Co., 1103 Harvard Street, Washington, D. C.

Inquiry No. 4393.—For the address of the makers of the Universal Extractors (Messrs. J. G. Lindner & Merz, of Germany).

The largest manufacturer in the world of merry-go-rounds, shooting galleries and hand organs. For prices and terms write to C. W. Parker, Abilene, Kan.

Inquiry No. 4394.—For makers of extracting apparatus for extracting oil from corn.

We manufacture anything in metal. Patented articles, metal stamping, dies, screw mach. work, etc. Metal Novelty Works, 43 Canal Street, Chicago.

Inquiry No. 4395.—For machines for printing and making shipping tags from the roll.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 4396.—For firms in Chicago, St. Louis, Kansas City or Memphis, dealing in second-hand boilers, engines, lathes, drill presses and machine shop fittings.

Contract manufacturers of hardware specialties, machinery, stampings, dies, tools, etc. Excellent marketing connections. Edmonds-Metzel Mfg. Co., Chicago.

Inquiry No. 4397.—For makers of chemical apparatus for extinguishing fires.

Representatives for Spain.—Hormaechea, Elorriaga & Co., Calle Libertad No. 1. Po. 1o., Bilbao, Spain. Offer their services to represent American manufacturers of novelties and new patented inventions. Will handle agencies to entire satisfaction, guaranteeing best service. A 1 references furnished to parties interested.

Inquiry No. 4398.—For parties engaged in making buttons from milk.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 4399.—For manufacturers and inventors of vending machines.

Patent 730,717. Permanent fixture. Cleans chimney in two minutes. Simple, no dust, child can operate. Illustrated in SCIENTIFIC AMERICAN July 4. Will sell outright or territory. Write for particulars. J. A. Stine, Manistee, Mich.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

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Scientific American Supplements referred to may be had at the office. Price 10 cents each.

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Minerals sent for examination should be distinctly marked or labeled.

(9089) M. H. N. asks: If a raceway measures 2 feet 6 inches deep and 5 feet 8 inches wide, and water flows at the rate of 60 feet per minute, what is the flow per hour, and what is the probable amount of horse power obtainable from a head of 18 feet? A. A flow of water 2 feet 6 inches deep by 5 feet 8 inches wide at the rate of 60 feet per minute, at a head of 18 feet, is, theoretically, equal to 28.9 horse power. About 75 or 80 per cent of this could be utilized commercially by a turbine, if the flow of water and head remain constant.

(9090) J. N. R. says: You will do me quite a favor if you will solve the following problem for me: Supposing we have a vessel with a hole in the bottom into which fits a hollow tube closed at both ends and six inches long. We will say this tube fits the hole so that no water could leak through, yet works with perfect ease. Now say we should put into this vessel four inches of water; what would the result be if the tube weighed one-fifth the weight of the water? Would the tube rise, or would it go through, or would it remain stationary? Have submitted this problem to several very "learned" men in this city, but none of them seem to "have time" to work it. They all say they *could* do it if they just had time. By solving the above for me and explaining why, you will confer a great favor. A. If the hole in the bottom of your vessel is round and smooth, and the hollow tube fits it perfectly and without friction, as you say, the tube will fall through the hole, whether there is water in the vessel or not, and it will take just the same force to hold it up when the vessel is full of water as when it is empty. The reason for this is that water exerts a buoyant effect on bodies which are immersed in it, by causing an upward pressure on the bottom of them. If your tube is so protected by the hole in the bottom of the vessel that the water cannot get underneath, it can have no buoyant effect. If you fill your vessel sufficiently full of water to have the water cover the upper end of the tube, the water will exert a downward pressure on the top of the tube, which should be added to the weight of the tube, in order to get the total force with which it tends to slide through the hole.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending July 7, 1903,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Abrading tool compound, K. Sakurai 733,082
Adjustable extension hanger, H. S. Burley 733,003
Advertising device and street indicator, electric, R. D. Lampson 733,053
Air brake, direct acting compressed, W. K. M. Hildebrand 732,856
Air brake, vehicle, J. S. Smart 732,789
Air forcing device for ventilation or similar uses, J. B. & J. Le Reau, dit L'Heureux 733,223
Alternator, C. A. Parsons 732,888
Amalgamator quicksilver feed, J. W. Swearingen 733,301
Anode mold, tilting, F. A. Thum 733,095
Atomizer tube polishing machine, C. L. Turner 732,801
Auger, earth, W. L. Iwan 732,859
Autocar brake, A. Govan 732,846
Automobile driving mechanism, E. Thomson 732,908
Automobile furnace draft device, F. C. Cheesewright 733,354
Automobiles, means for regulating the power of, E. Thomson 733,093
Autotruck, C. L. & R. A. Schultz 733,084
Awning, C. H. Hansen 732,739
Bag holder, D. W. Mitchell 733,247
Ball. See Golf ball.
Ball seam, base, B. T. Rogers 732,962
Ballot box, J. McGaughey 733,070
Band tightener, D. Mullane 732,773
Bank, savings, A. C. Mills, Jr 732,770
Bars. See Nigger bar.
Barn, J. Scheidler 732,787
Barrel heading machine, J. B. Stanhope .. 732,793
Bath brushes, showering device for attachment to, T. De Vilbiss 733,018
Bearing, anti-friction, G. N. Toms 733,348
Bed bottom, Vtipil & Splavec 732,976
Bed rail lock or connection, M. Benjamin. 733,127
Bee nursery, queen cell shield and queen, A. Stanley 732,794
Beer, converting wort into, Selg & Guntrum 733,284
Bell ringer, electric, T. Lidberg 733,225
Belt, body, W. J. Teufel 733,092
Belt controller, Michaud & Bricker 733,067
Belt or chain tightener, A. Anderson 733,113
Beverage dispenser, G. A. Logan 733,228
Bicycle repair plug, D. H. Cox, Jr 733,014
Blackboard attachment, F. D. Jones 732,863
Blow torch, vest pocket, F. J. Walter 732,805
Boat, submarine, F. T. Cable 732,920
Boiler furnace, E. F. Edgar 732,723
Bolt, O. O. Bahle 732,817
Bolster roll, J. B. Jones 732,864
Book, duplicating sales, N. S. Wright 733,309
Book or periodical, I. Kitsee 733,218
Book, orders out, E. M. Davis 732,717
Book page marker, R. R. Miller 733,326
Bookbinding machine, G. Wallner 732,910
Boring holes for screw pins or dowels in wooden railway sleepers, etc., tool for, F. Stahl 733,340
Boring machine, variety, M. L. Andrew 733,115
Bottle cap, H. S. Brewington 733,352
Bottle holder and protector, J. W. Graeme 732,936
Bottle manufacturing machine, glass, T. W. Simpson 732,902
Bottle, non-refillable, E. M. & T. H. Mars 733,062
Bottle, non-refillable, G. H. Spafford 733,293
Bottle or vessel stopper device, Sullivan & Freeman 733,344
Bottle stoppering machines, etc., automatic feeder mechanism for, F. O. Woodland 732,987
Bottles, etc., packing, A. Mauser 733,242
Bottles or similar vessels, closure device for, B. F. Miner 732,877
Box, E. Gerbereux 732,844
Box, H. P. Guyton 732,848
Box filling and closing machine, paper, R. P. Brown 732,703
Box forming machine, C. W. Miles 732,769
Brake for electric or other tram cars or vehicles, G. Atherton 732,914
Brake handle, J. Grady 733,185
Brewing apparatus, W. Griesser 733,189
Brick, M. J. Murphy 733,069
Brick drying apparatus, H. H. Walsh 732,978
Brick machine, H. G. Smith 733,338
Brickwork metallic bond, H. E. Grant 733,187
Brick package, W. Griesser 733,190
Brushes, manufacture of, J. F. Mumford. 733,251
Bucket, coal, J. C. Burgess 733,002
Buckle, J. E. Mitchell 733,248
Building block, Cuatt & Annis 732,832
Building block lifter, L. P. Normandin 732,884
Burner. See Gas burner.
Burner, G. Machlet, Jr. 733,235, 733,236
Burglar alarm, R. J. Fletcher 732,727
Cable hanger, E. S. Marsh 733,064
Cable lubricator, M. J. McGill 733,255
Camera attachment, W. R. Smith 733,292
Can opener, G. F. Hall 733,194
Can or vessel, E. M. Jones 732,862
Cap or closure for receptacles, safety, F. B. Joy 733,213
Car body, folding, G. S. Grant 732,847
Car, burglar-proof express, J. W. Vaughan 732,802
Car coupling, J. W. Smith 732,790, 732,791
Car door, S. J. Johnson 732,947
Car fender, W. Johnston 733,048
Car protecting device, C. Zimmerman 732,988
Car, railway, L. A. Shepard 733,285
Cars, etc., burglar-proof compartments for railway, C. Zimmerman 732,989
Cars, railway carriages, etc., bogie or truck for tram or railway, A. S. Nelson et al. 732,882
Cars, speed changing device for motor, A. Angst 732,993
Carriage wheel joint support, J. Scannell .. 732,899
Cash register, pocket, A. G. Huettel 733,045
Casing manufacturing machine, A. Mauser. 733,241
Cask, reinforced cylindrical, W. G. Avery 732,995
Celluloid or pyroxylin compound and making same, E. Zuhl 733,110
Cement testing machine, J. W. Bramwell. 733,136
Centering, collapsible, B. H. Muehle 732,881
Chair, A. Gruenwald 732,736
Checkrein hook, J. H. Royer 732,963
Chimney flue thimble, H. Anderson 732,912
Chlorate and perchlorate, electrolytic manufacture of, P. Lederlin 732,753
Cigar box, M. Brown 732,919
Clasp, C. H. Tomlinson 732,798
Clock, E. Fitch 733,180
Clock, electric, U. L. Collins 733,159
Clothesline hook and elevator, D. M. Chamberland 732,711
Clutch mechanism, C. Jenatzy, Fils 732,943
Coal box, C. Burwell 732,706
Coal handling machinery, T. A. Coffin 732,923
Coal, etc., means for cutting, H. V. Neukirch 733,073
Coating iron with zinc, electrolytically, E. Goldberg 733,028
Coils, forming, J. W. Lundskog 733,234
Coils, winding, J. W. Lundskog 733,233
Coin detector chute, O. Jaeger 732,746
Coke oven operating apparatus, P. B. Hasbrouck 733,036
Collar pad, horse, J. R. Roach 732,961
Collar, safety set, C. Cloukey 732,714
Colter clamp, J. Clayton 733,155
Combs, manufacturing, W. S. Bechtold 732,997
Combing machine, Hoyle & Scarborough 733,043
Computer, interest, L. M. Landing 733,054
Concrete piles, forming, F. Shuman. 733,336, 733,337
Connecting and strain equalizing device, F. Hackmann 733,322
Copying press, Davison & Woolley 732,833
Core, collapsible mold, A. S. Cramer 733,313
Corn receiver, N. Edwards 732,838
Corn shredders and huskers, band cutters and feeders for, N. G. Robinson 733,275
Corrugating tool, J. Blumer 733,131
Cot and tent, combined, I. L. Gleason 732,733
Cot, knockdown, J. Linden et al. 732,755
Cotton chopper, F. F. Gerding 732,934
Cotton chopper, H. F. Mackey 733,237
Cotton gin brush, T. Brantley 732,999
Cotton huller, cleaner, and gin feeder, E. B. Larson 732,869
Cotton in cotton boxes, means for equalizing the distribution of, M. A. Stephenson .. 732,969
Coupling rod jaws, manufacture of, P. Meyer 732,876
Cream regulating device for separators, W. W. Price 733,273
Cream separator, Odell & Egan 732,886
Cream separator, centrifugal, P. L. Kimball 732,750
Crushing mill, three roll, J. J. E. Bekker .. 733,125
Cultivator, C. H. Grassing 733,031
Current motor, C. W. Vliet 733,304
Curtain fixture, A. Farland 732,932
Curtain pole bracket, H. Bitner 732,821
Curtain shade and pole hanger, combined, M. D. Powers 733,272
Cushion for reciprocating beds or other moving parts, T. M. North 733,331
Cutter. See Formed cutter.
Cutter head, J. M. Kuebler 733,221
Dam, R. C. Beardsley 733,123
Dental jig, W. E. Griswold 733,321
Dental securing device, W. E. Griswold .. 733,320
Dentists' tapers, composition for, L. C. Mandel 733,061
Deodorizing device, R. C. De La Hunt 732,926
Derailment brake, W. R. Carroll 732,921
Designs and jacquards for same, apparatus for making, I. Kitsee 732,948
Die cutting machine work holder, B. J. Abbott 732,691
Display card, E. Zoller 732,810
Distilling apparatus, water, J. M. Coffman 732,831
Ditcher, J. D. Brown 732,702
Ditching machine, W. H. Johnston 732,747
Door closer and check, M. Klingler 733,219
Door hanger, G. W. Holly 733,041
Doors, gang locking mechanism for cell, A. J. Horgan 733,203
Dough dividing and compressing or molding apparatus, J. Callow 733,143
Draft producing device, C. Scott-Snell 733,339
Draft rigging, W. Thornburgh 733,094
Drawer, J. L. Dunning 732,721
Drawer lock, A. Stoeffler 732,971
Dress suit case, J. P. Whitney 732,983
Drier feeding apparatus, M. M. Graves 732,735
Dry battery, Fishell & Moffett 733,178
Drying machine, fabric, J. M. Levy 733,224
Dye and making same, red azo, K. Schirmacher 733,280
Electric arc light, F. Buchanan 733,135
Electric brake, W. B. Potter 733,271

(Continued on page 53)

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Electric cable trough or conduit, underground, T. E. Devonshire 733,169
Electric carriers, means for varying the speed of overhead, H. M. Harding.... 733,035
Electric furnace, P. L. T. Heroult..... 733,040
Electric lighting device, H. C. Graybill..... 733,188
Electric machine, dynamo, C. P. Steinmetz. 732,906
Electric motor controller, Merrick & Stull. 732,875
Electric switch, C. F. Autenrieth 732,695
Electric switch, J. D. Ihlder 732,745
Electric switch, push button, C. G. Perkins 732,890
Electrical apparatus for use of ultra violet rays, F. F. Strong 733,343
Electrical apparatus switch, E. R. Carichoff 733,146
Electrolytes, preparing, W. Gardiner 732,843
Electromagnet, I. G. Waterman 733,097, 733,305
Elevator, D. R. Macpherson 733,238
Elevator alarm signal, E. L. & G. Hail.... 732,737
Elevator automatic stopping device, J. Kobos 732,868
Embossing die, E. D. Macfee, Jr..... 732,762
Empyema drainage device, M. Chisholm... 733,152
End gate fastener, Davis & Mikkelson.... 733,165
End gate fastening, wagon, H. A. Schermerhorn 732,965
Engines, reversing gear for steam or other, H. Lentz 733,058
Engraving machine, J. T. Austin 732,694
Ensilage machine, E. W. Silver..... 733,289
Entrance closing apparatus, J. Wendler.... 732,982
Exercising apparatus, H. M. Hansen..... 732,740
Exhaust mechanism, E. Karrer..... 732,748
Exhibiting reflected images, apparatus for, W. K. Dickson 732,838
Extracting apparatus, E. Heimann..... 733,200
Eyeglasses or spectacles, A. Akeson..... 732,991
Faucet, J. Brizard 732,824
Feed bag, J. A. Gray 733,032
Feeders and band cutters, regulating means for self, C. C. Palmer 732,956
Fence post, R. T. Van Valkenburg..... 732,974
Fence post, P. Chapman 733,150
Fence weaving machine, wire, G. W. Whittington 732,984
Fiber cleaning machine, M. Prieto 733,080
File, paper or card, E. W. Woodruff..... 732,807
Filter, sand, G. Engel..... 733,174
Finger ring, C. Gosling 733,029
Fire escape, Yeager & Rixstine 732,808
Fire escape, C. N. Johnson 732,946
Fire extinguishing apparatus, E. Zimmerman 732,990
Firearm ejector, H. L. Powell 732,891
Fireproof window casing and sash, C. Schroeder 732,901
Fishing and trapping device, R. F. Armstrong 733,118
Flashlight apparatus, L. Susanka 733,300
Floor polisher or oiler, C. Weil 733,098
Flooring, J. W. Heaton 732,741
Flow regulating device for solid materials, G. Engel 733,175
Flushing apparatus, H. F. Neumeyer 732,776
Folding box, G. H. Savacool 732,964
Folding chair, A. R. Milner..... 732,771
Food product and producing same, A. A. Dunham 732,929
Fork. See Hay fork.
Formed cutter, C. W. Brock 733,311
Fruit gatherer, Bennett & Allen 733,128
Fuel, artificial, M. F. Ward 732,979
Fumigating apparatus, J. D. McReynolds.. 732,774
Funnel and device for supporting same, measuring, L. H. Sternheimer 733,294
Furnace top, blast, Hamfeldt & Tesch.. 733,196
Furniture, leaf support for articles of, O. R. Hunt 733,046
Galvanic battery, E. L. Anderson..... 732,811
Game apparatus, E. G. Matthewson..... 732,952
Garment fastener, T. O. Hegg..... 733,199
Garment supporter, J. Wilkinson..... 733,102
Garment supporter, R. H. Waters..... 733,306
Gas burner, C. W. Taylor..... 733,091
Gas burner, B. Columbus..... 733,160
Gas burner and pilot light, electrically controlled, H. W. Webb..... 732,980
Gas check, Bunsen burner, L. T. Weiss.... 732,981
Gas engine, W. E. Nageborn..... 733,256
Gas furnace, E. P. Reichhelm..... 733,274
Gas generator, acetylene, J. H. Mount.... 733,328
Gas producer, A. Leclere..... 732,950
Gas purifier, E. F. Lloyd..... 732,756
Gas purifier, centrifugal, H. A. Humphrey. 733,206
Gas receiver, escape, J. E. Claytor..... 732,712
Gas valve, time, H. McDuffie, Jr..... 733,254
Gate, W. S. Harmon..... 733,197
Gearing, Dayton & Brennan..... 732,834
Gearing, power transmission, Nye & Jenkins 733,076
Gearing, reversing, A. Hrncjar..... 733,205
Glass blower's tube, J. D. Blakeley..... 733,130
Gold from ores, apparatus for extracting, H. R. Cassel..... 732,709
Gold from ores, extracting, H. R. Cassel... 732,708
Gold ball, E. Kempshall..... 733,216
Grain drier, H. T. Goss..... 733,030
Grain steepers, combined clearer and lifter for, V. Lapp..... 733,055
Gramophones in and out of operation, device for throwing, T. Birnbaum..... 732,820
Grate, rocking, E. F. Edgar..... 732,722
Grinding machine, O. S. Walker..... 732,803
Ground, forming openings in the, F. Shuman 733,335
Gun carriage, field, Dawson & Buckham.... 733,166
Hair drying comb, Johnson & Bradner.... 732,860
Harvester, E. A. Mainguet..... 732,763
Harvester, corn, N. Bader..... 732,816
Harvester reel support, J. F. Appleby.... 732,994
Harvester wing, corn, H. M. Burdick..... 733,140
Hay fork, W. Louden..... 733,230
Hay rakes, automatic pawl trip for horse, E. A. Johnston 732,861
Head light reflector, F. Buchanan..... 733,136
Heating and ventilating apparatus, combined, G. Beddow..... 732,698
Heating apparatus, A. Kehm..... 732,749
Heating apparatus, J. T. March..... 732,951
Heating furnace, J. A. Herrick..... 732,938
Heating furnace, continuous, R. B. Kernohan 732,866
Heel cushion and ventilator, shoe, J. H. Denton 733,167
Heel scouring machine, W. B. Arnold..... 732,814
Heeling jack, shoe, J. H. Mullen, Jr..... 733,250
Hinge, spring, K. V. Clark..... 733,153
Hook. See Checkrein hook.
Hook and buckle, combined, B. S. Kearney. 732,865
Horseshoe blank bending machine, C. Arbuthnot 733,117
Hub, spring, H. A. Krezdorn..... 732,751
Hydrate of calcium peroxid, manufacturing, G. F. Jaubert..... 733,047
Illusion device, A. A. Welsh..... 733,359
Incandescent light holder, R. E. Hess..... 733,356
Incubator, J. W. Porter..... 733,270
Induction motor, alternatng current, C. S. Bradley 732,822
Induction motor, variable speed, C. P. Steinmetz 733,341
Inhaler, S. O. Goldan 733,026, 733,027
Injector, steam, J. Desmond..... 733,168
Inkstand, J. M. Keep..... 733,050
Insect collecting machine, C. L. Ferriott.. 733,020
Internal combustion engine, H. F. Wallmann 733,350
Ironing board, folding, H. Majors..... 732,764
Jar opening or closing tool, J. H. Stull.. 733,298
Jewelry stand or easel, W. B. Christopher.. 732,828
Journal box packing holder, railway, E. J. Trudeau 732,800
Keyboard and attachment therefor, G. L. Noe 733,261
Knob, sheet metal, W. A. Turner..... 733,973
Label, metallic, A. Chandler..... 733,148
Labeling machine, J. G. Hendrickson, 733,038, 733,039
Ladder, W. W. Pope..... 733,269
Ladle truck, M. McDowell..... 733,253
Lamp burner, C. H. Compton..... 733,012
Lamp, electric arc, Broderick & Gordon.. 732,701
Lamp, gas, R. M. Dixon..... 732,928
Lamp globe holder, arc, G. E. Stevens.... 733,342
Lamp, hand signal, Hopson & Priest..... 732,941
Lamp, incandescent gas, C. A. Haas..... 733,192
Lamp, oil, A. V. Campbell..... 733,004
Lamp or burner, Argand, H. C. Dunnemann 732,930
Lantern, signal, Mercer & Phillips..... 733,243
Latch, gate, J. J. Hynding..... 733,208
Lifting or screw jack, J. M. Marzolf..... 733,240
Liquids, apparatus for pouring out, W. Schmitt 733,083
Liquids from solids, apparatus for separating, Duncan & Sherriff..... 732,720
Lithophone and Glauber salt, making, W. D. Gilman 732,732
Load transporting apparatus, R. A. Needham 733,257
Lock, N. W. Crandall..... 733,163
Lock and latch, C. J. Caley..... 733,142
Lock and latch, E. H. Dimock..... 733,171
Locking mechanism, coin controlled, G. P. Moore 732,772
Locomotive, S. N. Mighell..... 732,768
Locomotive heater, compressed air, W. R. Pratt 732,892
Log or lumber hauling attachment, S. H. Chase 733,007
Loom, E. Powell..... 733,333
Loom harness mechanism, E. S. Stimpson ..733,089
Loom needle motions, stop mechanism for, G. F. Hutchins..... 733,207
Loom shedding mechanism, G. B. Ambler.. 732,992
Loom warp stop motion, J. Northrop..... 732,885
Loom warp stop motion, H. A. Owen..... 733,077
Loom warp stop motion, A. K. Pratt.... 733,079
Lubricator, Fisher & Krosli..... 733,179
Lumber surface meter, J. D. Bates..... 732,697
Lumber trimmer, automatic, Willett & Steedman 733,103
Magnet, solenoid, G. T. Hanchett..... 732,851
Mail bag, W. and W. M. Rohde..... 733,081
Mail bags, etc., buckle for sealing, J. Anschau 733,116
Mail box, J. W. Snedeker..... 732,904
Mail catcher and deliverer, J. W. Gilbert.. 733,025
Maps, etc., device for carrying and supporting, P. R. Bullard..... 733,137
Marble making tool, Converse & Leiter... 733,013
Massage machine, A. D. Jones..... 733,049
Massaging apparatus, G. Sartori..... 732,897
Mattress stuffing machine, A. R. Kezer.... 733,324
Measuring device, liquid, C. Simon..... 733,290
Mechanical movement, E. D. Gleason..... 732,845
Mechanical movement, G. H. Burpee..... 733,141
Mechanical movement, D. Felgar..... 733,177
Mechanical movement casing, A. Wahle.... 732,977
Metal bars into sheets, reducing hot, T. V. Allis 733,112
Metal polishing machine, F. A. Weisbecker. 733,099
Metal tubes or pipes, die for manufacture of, J. Reimann 732,960
Metallic box, J. Nutry..... 733,332
Metallic tie and rail fastener, C. A. Wills. 733,104
Meter. See Lumber surface meter.
Mine curtain, A. O. Slentz..... 732,903
Mirror support, J. M. Conroy..... 733,162
Mold, J. Schinharl..... 732,966
Mold, E. M. Campen..... 733,145
Molding apparatus appliance, L. Berg..... 732,918
Mop and scrub brush, combined, A. S. Held ..... 732,742 to 732,744
Mop wringer, M. A. Elliott..... 733,317
Motive power agency support, H. Lemp.... 732,872
Motor, A. J. Burton..... 732,705
Motor, U. S. King..... 733,217
Motor control system, W. O. Mundy..... 733,252
Motor, meter, or pump, W. Ballerstedt... 732,818
Motors, changing the frequency of single phase induction, P. E. Chapman..... 733,149
Muffler, A. G. New..... 733,330
Music sheets, device for trimming perforated, L. D. Doman..... 733,016
Musical instrument, J. A. Bartholomew.. 733,122
Musical notation, L. H. Berwick..... 733,351
Nail cleaner, infant's, G. J. Barnes..... 732,819
Napkin holder, sanitary, F. M. Baldwin.... 733,120
Nicotin catcher, H. Feix..... 732,841
Nigger bar, J. H. E. Auger..... 732,815
Nozzle, spraying, D. J. Seaman..... 733,334
Nozzle, steam, W. S. Clarkson..... 733,154
Nut lock, L. Savaria..... 732,898
Nut lock, J. Edwards..... 733,173
Nut lock, Miller & Stinger..... 733,245
Oil, refining, C. B. Graham..... 732,937
Optical projection apparatus, J. Szczepanik. 733,099
Packing, metallic waste, A. L. Cole..... 733,156
Paint and producing same, water, S. S. and B. Ruston 732,895, 732,896
Paint, water, S. S. & B. Ruston..... 732,894
Paper cutter, J. L. Lee..... 732,754
Paper machine vats, valve for, J. E. Foy.. 733,022
Paper serving fixture, toilet, A. H. Scott.. 733,281
Paper, toilet, A. H. Scott.....733,282, 733,283
Paste and cutting same, apparatus for winding flat strips of, A. Currle..... 733,164
Pea pods from vines, machine for picking, G. W. Kelley 733,215
Pedal attachment, L. O. Peterman..... 732,957
Pencil holder and guard, S. J. Dohrmann.. 733,172
Perforating machine, F. P. Rosback..... 732,893
Pessary, E. M. Hewish..... 732,855
Pessary, W. W. Mitchell..... 733,068
Phosphorus, making, R. K. Duncan..... 733,316
Phosphorus making apparatus, R. K. Duncan 733,017
Photographic plate developing apparatus, G. A. Hagner 733,034
Photographic plate washer, W. G. Mette.. 733,244
Photographic printing apparatus, H. H. McIntyre, reissue 12,130
Pick, miner's, A. Walker..... 733,349
Pigment production, manufacture of material for use in, L. Wirtz..... 733,308
Pile for forming concrete piling, removable, F. Shuman 733,286, 733,288
Piles, making concrete, F. Shuman..... 733,287
Pipe connection, F. G. Tallerday..... 733,346
Pipe joint, flexible, J. C. Martin, Jr..... 733,065
Pipe wrench, F. D. Bullard..... 733,138
Planter, T. M. Griffin..... 733,033
Planter, seed or potato, C. H. Gerling..... 732,731
Pliers, H. C. Condit 732,715
Plow cover or protector, A. Luenberger... 732,873
Pocket, garment safety, J. A. Barling..... 732,996
Polishing cone and wheel, L. G. Koenig.. 732,949
Post. See Fence post.
Power transmissior, J. L. Follett..... 732,933
Precious stone setting, J. C. Nordt. 733,262, 733,263
Printing press cylinder, O. Roesen. 733,276, 733,277
Printing machine feed guard, W. Spalckhaver 732,792
Printing press, J. Krehbiel..... 733,325
Printing press ink distributing mechanism, G. H. Pierce..... 733,078
Printing press inking apparatus, M. Gally.. 733,023
Printing press platen, J. Thomson..... 732,797
Propulsion apparatus, vessel, C. M. Coen.. 733,010
Pump, rotary, C. W. Loomis..... 733,229
Pump spring attachment, J. O. Bane.... 733,121
Pump, steam, F. D. Clinger..... 732,713
Pumping system, J. Bryan..... 732,704
Punch, T. E. Gray..... 733,319
Punch, hand, R. Hayden..... 732,850
Puzzle, E. S. Mowry..... 732,954
Radiator section connection, C. F. Gessert. 733,183
Rail joint, H. T. Campbell..... 733,144
Railway brake, P. Hallot..... 733,195
Railway brake, S. Cheney..... 733,312
Railway rail joint plates, manufacturing, S. B. Sheldon 733,085
Ram, portable pneumatic, J. B. Barnes..... 733,696
Range finding device, F. E. Molkow..... 732,878
Refrigerator, R. R. Graf..... 733,186
Refrigerator, counter, Jensen & Reissner... 732,945
Regenerative apparatus, J. A. Herrick..... 732,939
Rein supporter, Henderson & Jerome..... 732,853
Revolver, D. B. Wesson..... 733,101
Retort walls, etc., composition of matter used for protecting, T. J. Carlton..... 732,707
Ribbon feed regulating device, Marvin & Casler 732,765
Ring roll, D. P. O'Brien 733,264
Robe holder, A. A. Jones..... 733,212
Rocker joint, O. C. Moore..... 733,227
Roller, B. E. Storr..... 732,907
Roof, L. P. Normandin..... 732,883
Rotary engine, J. S. Moseley..... 732,880
Rotary engine, J. Knowles..... 733,052
Rotary engine, A. I. Ostrander..... 733,265
Rubber roll, J. B. Forsyth..... 732,728
Rule, slide, W. H. Glaser..... 732,935
Safes, electrical signal for adding security to, W. E. Arnold..... 732,813
Safety pin, double, J. M. Howley..... 733,204
Sander drum, B. Storm..... 732,796
Sash hanger, storm, O. F. Abrahamson.... 732,692
Sash lifter, G. Cassady..... 733,147
Saw, drag, L. Phillipps..... 732,958
Saw guide, band, Trout & Hinkley..... 732,799

(Continued on page 54.)

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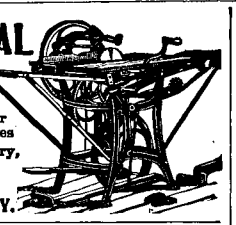

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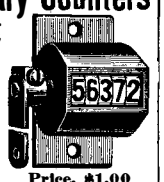

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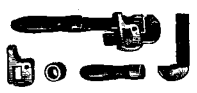

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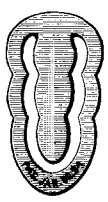

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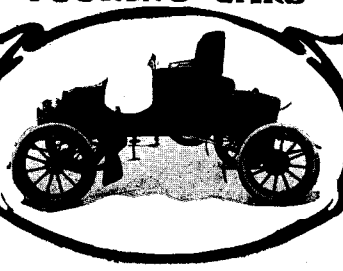

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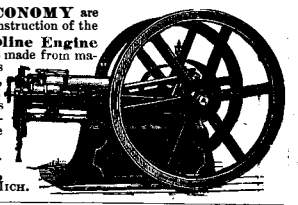

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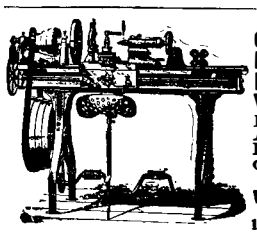

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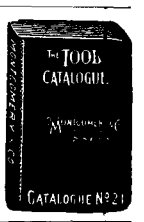

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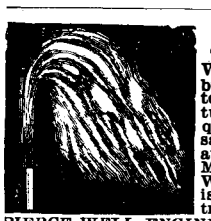

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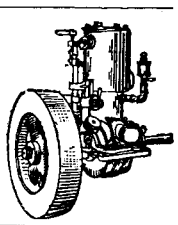

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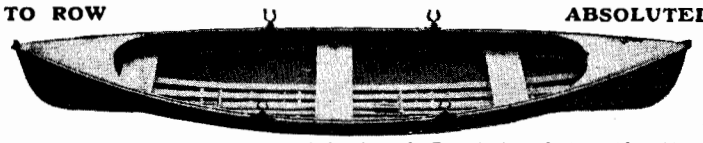

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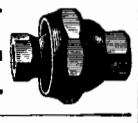

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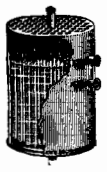

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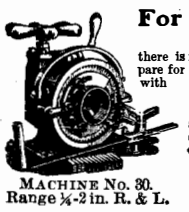

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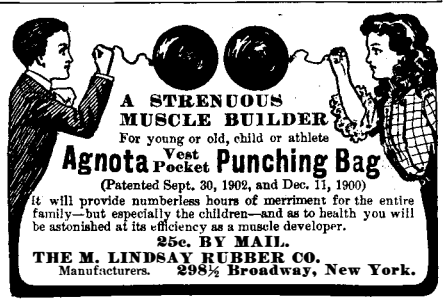

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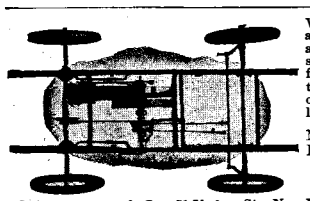

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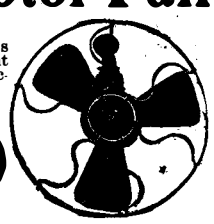

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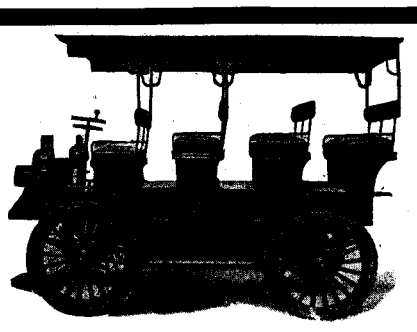

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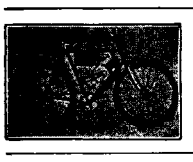

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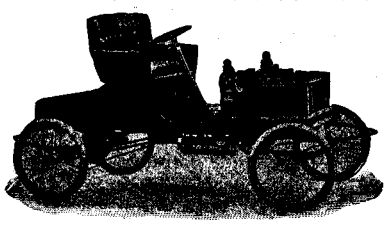

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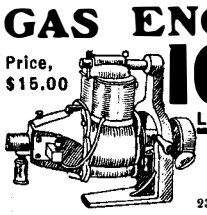

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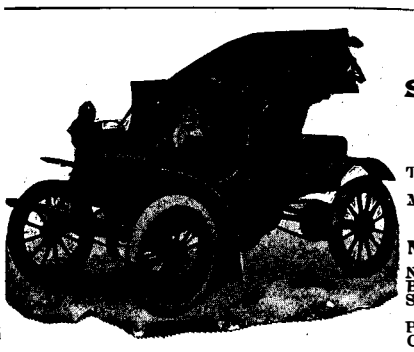

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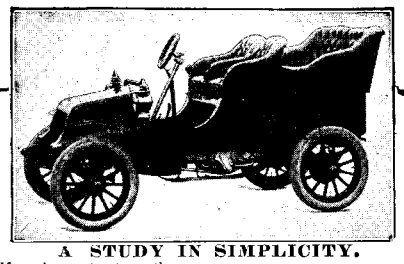

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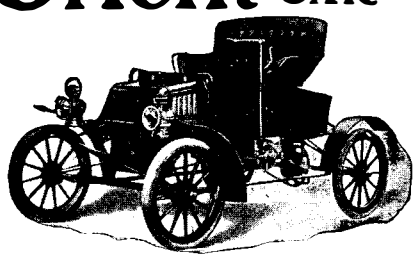

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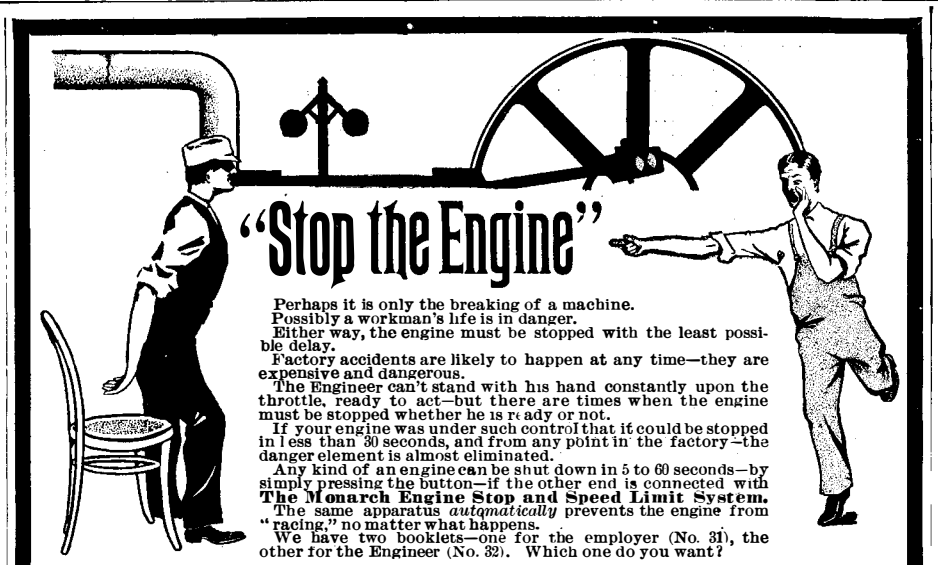

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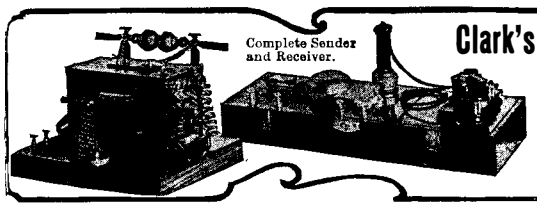

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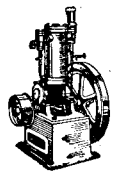

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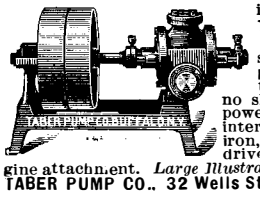

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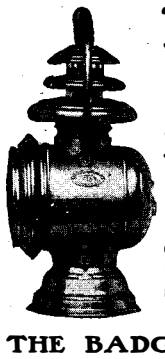

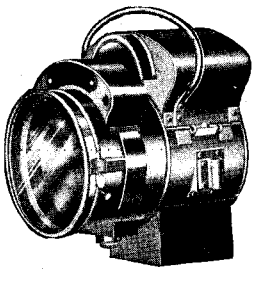

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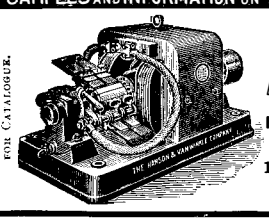

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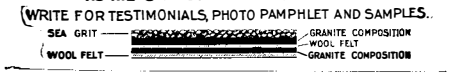

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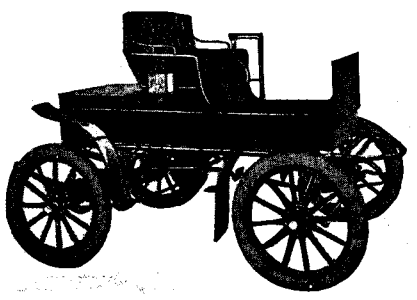

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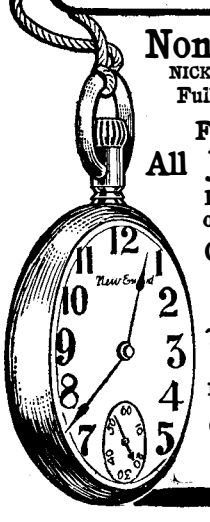

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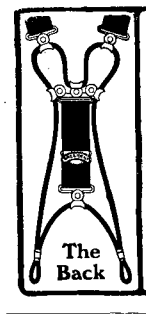

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